Our Living Oceans

The Economic Status of U.S. Fisheries

1996

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The Economic Status of U.S. Fisheries

1996

December 1996
NOAA Technical Memorandum NMFS-F/SPO-22

U.S. Department of Commerce

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Foreword

The National Oceanic and Atmospheric Administration's National Marine Fisheries Service has the exciting challenge of leading the environmental stewardship of our Nation's living marine resources. Through scientifically based rebuilding and maintenance of our fisheries resources, NOAA's vision for the next decade is to increase the Nation's wealth and quality of life for Americans by ensuring sustainable fisheries that provide safe seafood, a healthy fishing industry, and recreational opportunities. For NMFS, this means stewardship of living marine resources for the benefit of the Nation through science-based conservation and management and promotion of the health of the environment.

This vision requires sound biological, economic, social, and environmental information to support the development of policy decisions and to track the performance of the agency over time. It relies on implementation of ambitious Fishery Management Plans (FMP's) prepared by eight Congressionally established Fishery Management Councils to resolve problems of: uncontrolled participation in fisheries, over-capitalization, overfishing, and resource depletion; controversial allocation decisions; and wasteful bycatch of nontarget species. All these efforts must be focused to ensure the biological and economic sustainability of fishery resources.

As NOAA Assistant Administrator for Fisheries, I am proud to release this publication on the current economic status of U.S. fisheries. This is the second in a series of three volumes that provide assessments on the biological health of our living marine resources (*Our Living Oceans*), the economic health of U.S. fisheries (this publication), and the health of marine/coastal habitat (forthcoming) under NOAA's stewardship. NMFS will use these periodic reports to measure its performance and success in achieving its goals and objectives, and provide the Nation with a scorecard of the health and status of its valuable renewable resources, the businesses and people whose livelihoods depend on them, and the underlying habitat on which both depend.

This report provides an economic overview of U.S. domestic fisheries. While the principal focus is on the commercial harvesting sector targeting wild stocks, sections describing recreational fisheries, commercial processing, international trade, and retail sectors are included. Together with chapters on topical fishery economics issues from around the Nation, the volume illustrates the complexity of quantifying the economic successes and failures of the Nation's fisheries and provides a baseline assessment from which to measure progress. Despite the U.S. position as the world's fifth largest fishing nation, the report highlights significant gaps in our fisheries information base and proposes ideas and solutions to improve the science basis of our actions. The report also examines trends in past and current fisheries management strategies. From the material in the report, both NMFS and the Nation can identify and track the significant environmental stewardship issues that we must resolve over the coming decade to ensure the sustainability of our fisheries.

Rolland A. Schmitten

Assistant Administrator
for Fisheries
National Oceanic and
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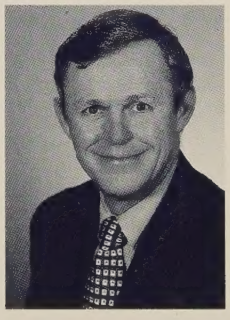
December 1996



Introduction

"NOAA's vision for the next decade is to increase the Nation's wealth and quality of life for Americans by ensuring sustainable fisheries that provide safe seafood, a healthy fishing industry, and recreational opportunities."

NOAA Strategic Plan, 1996

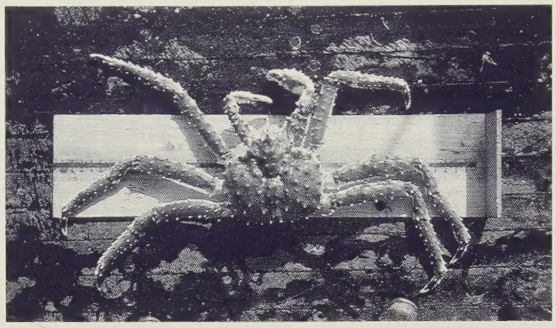
The Nation's living marine resources (LMR's) are under the stewardship of the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS). The preceding quote is NOAA's vision statement for the future of LMR management. The agency has had great success in assessing and predicting the biological status or health of fishery stocks, and has made recent progress in managing for biologically sustainable fisheries. NOAA is now poised to begin incorporating management strategies which ensure that fisheries are also economically sustainable. This report defines and characterizes economic sustainability in fisheries, and presents a preliminary assessment of the economic health of the Nation's fisheries. Management options that might best promote a healthy fishing industry in the long run are discussed. Thus the report complements the agency's biennial report on the biological status of fishery resources, *Our Living Oceans*, with a comprehensive description of the economic status of the Nation's fisheries. It also suggests some prescriptions for better economic health.

Our Living Oceans (USDOC, 1993) defines a fishery resource as fully utilized "...when the amount of fishing effort used is about equal to the amount needed to achieve long-term potential yield (LTPY) and where the resource is near its LTPY level." The resource is overutilized "...when more fishing effort is employed than is necessary to achieve LTPY." These definitions are characterized as biological indicators of health because they have as a reference point the achievement of LTPY, the maximum sustainable level of harvest from a biological standpoint. From an economic standpoint, a fishery resource is optimally utilized when the amount of fishing effort used to achieve any level of harvest is at the point where net economic benefits to the Nation are greatest, or at lowest cost for that level of harvest. This means harvesting only to the point where the additional benefits from harvesting the last fish just equal the additional costs incurred to harvest it. At harvest beyond that point, resources like capital and labor would be put to better use in other parts of the economy, because the cost of using them to catch more fish is greater than the benefit provided by having the extra fish. In many fisheries, the economically sustainable level of harvest is lower than the biologically sustainable level.

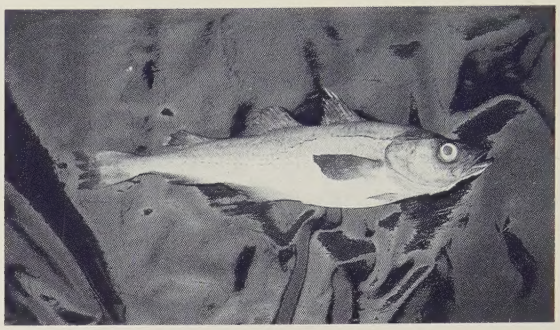
It is important to employ management strategies that ensure economic sustainability because left unregulated, most fisheries will operate at levels of harvest greater than both the biologically and economically sustainable points. This occurs because most U.S. fisheries are subject to conditions of open access, meaning that participation is unrestricted. The biological, economic, and managerial problems associated with open access are well known. These include lower yields, declining stock and harvest levels, "derby" style fishing where fishermen race to catch limited amounts of fish, shortened fishing seasons, excess capacity to harvest and process fish, unsafe fishing conditions, volatile prices and landings patterns, excessive bycatch, and lower product quality.

Traditional solutions to the problem of open access, such as regulations defining allowable gear types, fishing areas, fishing seasons, and total catch, have not succeeded in achieving economic sustainability. This "command-and-control" type of management has sometimes stabilized or reversed the decline in the biological status of stocks, but has not been able to produce positive net economic benefits to the Nation. That is, while some of the Nation's fisheries are considered sustainable from a biological perspective, they may still be economically unhealthy in the sense that the same level of harvest could be achieved with less effort, and at lower cost.

In 1993, of the 163 U.S. fisheries whose biological status could be assessed, 40% were classified as overutilized and 43% were fully utilized. Among these are the valuable New England groundfish, Atlantic scallop, Gulf of Mexico



King crab (NMFS photo).



Pollock (NMFS photo).

shrimp, and Alaska king crab fisheries (USDOC, 1993). In some of these fisheries, drastic measures have been implemented to halt the decline in stock levels. For example, in the Northeast Region, current management of the groundfish and scallop fisheries requires a 50% reduction in fishing effort over the next five years just to stabilize the stocks. In Washington and northern Oregon, the commercial salmon fishery was closed down completely in 1994. The U.S. total allowable catch (TAC) for Atlantic swordfish declined 13% between 1994 and 1995, and will decline another 12% in 1996. Causes typically cited for the declines include overfishing, deteriorating environmental conditions, loss of habitat, and changing oceanographic conditions. On the other hand, Alaska pollock and other groundfish are considered biologically healthy, and harvests of these Alaska resources accounted for almost half the volume of the total U.S. harvest in 1994, and about 15% of the ex-vessel revenues (USDOC, 1995). However, these high harvest levels are achieved by increasingly more and bigger vessels fishing during shorter and shorter seasons. These inefficiencies result in tremendous costs to the Nation.

Support for managing fisheries for economic growth is embodied in the Magnuson Fishery Conservation and Management Act (MFCMA), which defines optimum yield as "... the amount of fish (A) which will provide the greatest overall benefit to the Nation, with particular reference to food production and recreational opportunities; and (B) which is prescribed as such basis of the maximum sustainable yield from such fishery, as modified by any relevant economic, social, or ecological factor (USDOC, 1990)." The MFCMA also provides guidelines for using economic principles in the development and modification of fishery management plans. Furthermore, under Executive Order 12866, regulations should have the goal of maximizing net benefits for society.

However, economic sustainability in fisheries, and greater net economic benefits to the Nation, can only be achieved by attacking the fundamental problem of open access head on. This requires implementation of controlled access management systems that provide fishermen with a vested interest to harvest quotas efficiently and in the least-cost fashion. The benefits to controlling access include steady harvest of fish throughout the season, stable prices, high product quality, efficient use of capital and labor in the overall economy, and safer fishing operations. In the few U.S. fisheries where controlled access systems have been implemented, the results have been favorable: ex-vessel prices are up, landings are spread more evenly throughout the season, capital (in the form of vessels) has been reduced, and stock levels are stable (see the Northeast Region's spotlight article on surf clam management, and the Southeast Region's harvest sector report on wreckfish management).

There is increasing pressure to allocate scarce fishery resources between competing commercial and recreational users, as well as environmental groups and other "nonconsumptive" users. To maximize net benefits for society, total allowable catches (TAC's) have to be allocated efficiently and equitably among user groups. Fisheries managers will need rigorous analyses of the economic value of alternative uses of fisheries to compare the costs and benefits of various management alternatives and to make defensible allocation decisions. As fisheries become more limited, management decisions will probably become

more contentious and more likely to be challenged in court. Information that allows the agency to demonstrate quantitatively that a chosen regulation has the highest net benefit to society is critical.

The role of this report is to provide a snapshot of the economic health of U.S. fisheries. Given NOAA's goal of sustainable fisheries, assessing some baseline measure of health now can help the agency gauge the degree and speed of progress made toward its goal over time. Since the economic tools and definitions used to measure the status of fisheries differ from biological tools, Chapter 1 describes these tools and their use in determining the value of fisheries to society. The primer provides explanations and definitions of basic economic concepts, approaches, methodologies, and tools of analysis.

Chapter 2 presents descriptive information regarding the current economic status of U.S. fishery resources at the national level. It also presents a review of some of the social, institutional, and economic forces that have shaped the development of the Nation's fisheries. The chapter includes a discussion of the retail demand for seafood. Detailed interpretation of trends in important fisheries by NMFS region are contained in the regional analyses of Chapters 3-7. The national and regional descriptive reports distinguish between the harvest, processing and wholesaling, recreational, and trade sectors since these represent the sectors associated with the fishing and seafood industry most likely to be impacted by fisheries management. A time frame of 1984 to 1993 is used wherever possible to capture gross changes in fishery conditions over the past decade and to provide some evidence of recent trends. All prices and values are reported in 1987 dollars unless otherwise indicated (i.e. nominal values are deflated by the Gross Domestic Product implicit price deflator, which uses 1987 as a base year).

In addition to the regional reports, a topical fisheries economic issue from each of the NMFS regions is analyzed. The issues addressed within these "spotlights" include: the rise and fall of the U.S. Pacific tuna industry; two facets of the problem of bycatch, one in the Alaskan groundfish fishery and one in the Southeast reeffish fishery; Hawaii's experience with limited entry programs; and the impact of ITQ's on the surf clam/ocean quahog fishery in the Northeast.

Tuna (NMFS photo).

Thus, the initial chapter of this report lays the groundwork for understanding how economic theory and analysis can be used in the fisheries management process, the spotlight articles illustrate the range and complexity of the real problems encountered by fisheries managers, and the descriptive chapters document important trends in U.S. fisheries. During the compilation of this report, for many fisheries the preferred indicators of economic health and measures of economic value could not be calculated due to a lack of appropriate data. In these cases, rather than presenting actual economic analyses, the report highlights what could be done if economic data were available, why economic analysis is important, and how this information could be used by fisheries managers. It also identifies data needs that have to be met to assess economic sustainability. A goal for future editions in this series is to be able to systematically evaluate the economic health of U.S. fisheries, using well-defined analytical indicators, as the appropriate data become available.

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Chapter 1

A Primer

Basic concepts and terms used in economic theory are presented in this chapter to help explain their use and importance in fisheries management. These terms are used throughout the report and provide some context for the relevance and usefulness of economics in understanding why and how fisheries can be managed for sustainable economic health.

Economics is the study of how individuals, firms, nations, and societies allocate scarce resources among unlimited wants. Allocation is the process of distributing resources such as labor, capital, and natural resources among uses and/or users. Since much of economics relies on the concepts of supply and demand, these terms are defined first.

Supply is a relationship which characterizes the amount of a good that producers would supply at each price. All else equal, the higher the price, the more producers are willing to supply. A supply curve (Fig. 1-1) graphically traces the incremental or marginal cost of producing a good for each level of production. Marginal cost refers to the additional cost of producing one more unit of a good. The supply curve is thus a marginal-cost curve. In fisheries, the supply curve can refer to a number of things: the supply of landings to processors, the supply of processed seafood products to consumers, or the supply of charter boat and party boat trips to recreational fishermen, for example. The term "cost effective" means that a particular level of a good is produced in the least costly method. Sometimes a distinction is made between private and social costs; social costs are those costs that are incurred by society from producing a good or service, while private costs are those incurred by an individual firm. For example, a firm that is allowed to pollute the environment in the course of its normal operations incurs only the costs of producing its product; the social cost of that production includes the cost of cleaning up the pollution or the costs of dealing with the consequences of the pollution.

The measure used to evaluate the benefits to producers or suppliers of a good is called producer surplus (PS), or rent, and is defined as the difference between total revenues (sales or gross value of production) and the total variable costs of production. Variable costs are those that vary with the level of production (e.g., expenditures on fuel); fixed costs are those that are incurred regardless of the level of production (e.g., an insurance premium on a vessel). Profits are the difference between total revenues and total costs, which include both variable and fixed costs. Graphically, producer surplus is represented by the triangular area OP_EA.

Demand is a relationship that characterizes the amount of a good that consumers would purchase at each different price. The higher the price, the less consumers are willing to buy. Graphically, the demand curve traces the price consumers are willing to pay for each additional, or marginal, unit of a good (Fig. 1-1). A benefit is the satisfaction or utility a consumer receives from consuming a bundle of goods or services. Marginal benefit refers to the additional satisfaction gained

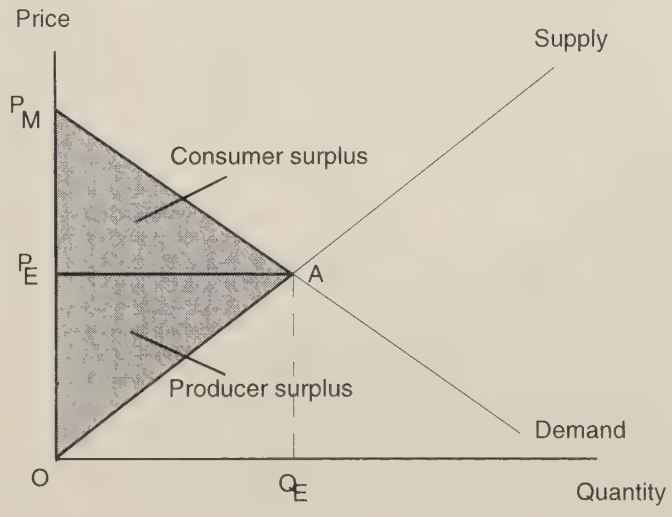

Figure 1-1
Consumer surplus and producer surplus: traditional measures.

from consuming one more unit of a good or service. The demand curve is thus a marginal benefit curve, and willingness to pay (WTP) is the total area under a demand curve. The concept of demand in fisheries can refer to a number of markets: the retail demand for seafood, producers' demand for harvested fish, or the demand for recreational fishing experiences. As with costs, there is a distinction between private and social benefits. Social benefits are the benefits accrued to society from the production of a good or service, while private benefits accrue to an individual consumer.

Consumer surplus (CS) is a measure of the net economic benefits to consumers from purchasing a good or service and it is defined as the difference between what a consumer would have been willing to pay for a good and the amount actually paid. Consumer surplus (area P_EP_MA in Fig. 1-1) is calculated as the total area under a demand curve up to the equilibrium quantity of a good (area OP_MAQ_E) less the total expenditure for that quantity (area OP_EAQ_E).

The demand and supply curves can indicate the responsiveness of consumers and producers to price changes. When a 1% change in price causes an increase or reduction in quantity purchased of more than 1% (or when the slope of the demand curve is relatively flat), demand is said to be price elastic. When a 1% change in price causes a change in quantity purchased of less than 1% (i.e. the slope of the demand curve is relatively steep), demand is said to be price inelastic. Similarly, supply is said to be price elastic (inelastic) when a 1% change in price leads to a change in quantity supplied by producers of more than (less than) 1%. Estimates of price elasticity are useful for determining the magnitude of changes in consumer and producer surplus when prices, or factors which might affect price, change.

Net economic benefits (NEB) are the sum of consumer and producer surpluses and represent the difference between the total benefits and total costs of an action. Net economic benefits are maximized when all resources have been allocated to their best use. Net present value (NPV) is a sum which reflects the value in today's dollars (i.e. discounted to the present time period) of net economic benefits that accrue over a period of time. Discounting reflects the rate of return that society is willing to accept or trade for sacrificing present consumption. The lower the discount rate, the more weight society places on future periods, and hence the more likely society will be to sacrifice consumption in the present time period. Conversely, the higher the discount rate, the more society "prefers" the current time period and the less likely it is to sacrifice present consumption. NPV is usually used to calculate the value today of all future net economic benefits (benefits less costs).

Economic efficiency is said to occur when resource allocation is such that net economic benefits cannot be increased by changing that allocation. In commercial fisheries, this would occur when fishermen harvest a given amount of fish using the most cost-effective combination of capital, labor, and other inputs. Efficient allocation of resources typically occurs through market processes, and it ensures that resources are channeled to their most valuable uses and to those who value them the most. The opportunity cost of a resource is the value of that resource in its highest valued alternative use. For example, the opportunity cost of labor of a fisherman is the wage or salary that could be earned in another occupation. The opportunity cost of a commercial fishing vessel is the return that could be earned by selling the vessel and investing the money elsewhere. The opportunity cost of a fish harvested today is the value of that fish if it were left in the ocean. The opportunity cost of harvesting a fish today might be high if the fish could be sold for a higher price per pound later when it is larger. In addition, if harvesting today precludes the fish from reproducing, the value of its foregone offspring is also included in the opportunity cost.

A market is a mechanism for allocating goods and services and consists of the buyers and sellers of a good or service. The intersection of supply and demand determines the market, or equilibrium, price, P_E, and equilibrium quantity, Q_E, of a good. In Figure 1-1, this is point A. This is the point where price is equal to marginal cost. In commercial fisheries, the primary markets are: the ex-vessel market (sales between harvesters and processors), the processing or wholesale market (sales between processors and wholesalers or processors/wholesalers and retailers), and the retail market (sales between retailers and consumers). All three markets are interrelated; for example, consumers' demand for seafood affects processors' demand for fresh fish.

Markets may operate differently depending on the number of consumers and producers involved.

When there are a lot of consumers and producers, homogenous firms and products, and perfect information, a market is said to be perfectly competitive (or operating under perfect competition), and no individual buyer or seller can influence the market price or equilibrium quantity. If there is only one producer of a good, the market is said to be a monopoly, and the producer controls the equilibrium price or quantity of the good. When there is more than one producer, but still only a few, the market is called an oligopoly. An oligopsony is a market with relatively few consumers or buyers. In fisheries, this occurs more often in the processing sector, when only a few firms purchase and process a particular species. Oligopsony can lead to distortions in the ex-vessel market because those few processing firms are able to individually influence the prices paid to harvesters.

A market failure occurs when a market cannot or does not take into account all costs or benefits of producing or consuming a good. When this happens, outside intervention (usually undertaken by government) is required to correct the market failure if the goal is to ensure that resources are allocated efficiently. Inappropriate intervention can exacerbate a market failure or be the source of an allocation inefficiency.

An open-access resource is a resource that is not owned or controlled by anyone, while a common-property resource is controlled by a clearly defined set of users but is not owned or controlled by an individual. In an open-access fishery, no one owns the fish stock. That is, use or property rights do not exist for fish in the sea (fishermen do not have to pay to take a fish from the ocean). Use rights exist when there is a system for assigning ownership to all or part of a resource. The problem inherent in open-access fisheries was described succinctly by Gordon (1954), who wrote that a fisherman has little incentive to control fishing effort because "... he who is foolhardy enough to wait for its proper time of use will only find that it has been taken by another."

Figure 1-2 illustrates the classic economic textbook analysis of an open-access fishery. The concave curve is a total sustainable revenue (TSR) function, defining the revenues that could be earned on a recurring basis at every level of effort (E). The straight line extending from the origin is a total cost (TC) curve, showing the costs of harvest at each level of effort. In fisheries economics, the term capital generally refers to vessels and gear, while effort is a combination of vessels, gear, labor and time used to catch fish. Maximum Sustainable Yield (MSY) is at the highest point of the TSR curve. MSY is the term used to refer to the maximum level of harvest that can be taken with the same level of effort on a recurring basis. MSY is a result found only in simulation models based on a Schaeffer or logistic biological growth model.

In open-access fisheries, theory predicts that effort levels will be at point E_{OA}, where the total sustainable revenues from fishing effort equal total costs (or where rents are zero). At every point from E=0 to E_{OA}, total sustainable revenues are greater than total costs (the TSR curve lies above the TC curve at every point). In an open-access fishery, vessels will continue to enter the fishery as long as TSR>TC. Entry occurs up to the point where TSR=TC because fishermen only consider the private costs of harvest, not the social costs. This constitutes a market failure because the private costs of harvest are less than the social costs, which include the opportunity cost of all the resources used (including capital, labor, and the fish themselves). A negative externality is said to exist when one individual's or firm's actions increases the costs or reduces the benefits of other individuals or firms. For example, if a firm deposits its wastes into a river which carries pollution downstream, and others have to clean the water before using it, the social costs may be greater

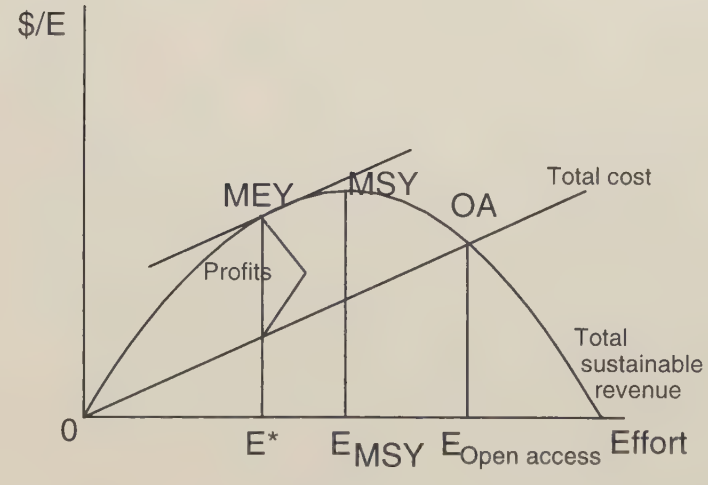

Figure 1-2
Maximum economic yield, maximum sustainable yield, and open-access yield.

than the individual firm's (or private) costs of production. In open-access fisheries, a number of negative externalities can exist. Two of the more commonly analyzed externalities in fisheries are: crowding externalities, which occur when congestion from too many vessels on the fishing grounds causes the marginal cost of harvest to increase, and stock externalities, which occur when the entry of another vessel reduces the fish stock enough to affect other vessels' fishing costs. In both examples, fishermen do not consider the cost of their actions on other fishermen, even though their actions may increase the costs of all fishermen.

Maximum economic yield (MEY) is the term used to refer to the level of harvest that provides the maximum returns, or net economic benefits, to society. MEY is where the difference between the TSR and TC curves is at its greatest; profits are maximized here. It can be seen that at MEY the total cost curve is tangent to the TSR curve (i.e. their slopes are equal). This level is the most efficient because at this point the cost of using an additional unit of effort to harvest (the marginal cost of effort) just equals the additional, or marginal, revenue or satisfaction (the marginal benefits) from using it. Moving in either direction from MEY reduces profits. At this point, the social costs of harvest are taken into account. Society would be better off operating at this point, because all resources would be put to their highest valued use. Less effort could be used to harvest the same level of fish that results in open access, and at lower cost. In simple bioeconomic models, MEY is less than MSY, or, the economically sustainable level of effort is less than the biologically sustainable level. MSY has traditionally been the goal of fisheries management.

When effort and harvest in a fishery occur at any point greater than MEY (i.e. anywhere to the right of point E^*), the fishery is said to be overcapitalized. Overcapitalization exists when more capital than is needed is used to produce the optimal level of a good. In open-access fisheries, this usually refers to the excessive number and size of vessels, as well as the amount of gear, used to harvest fish. In most simple bioeconomic models, this is effort to harvest beyond MEY. Overcapitalization can represent an economic waste to society because the capital and labor needed to harvest at levels greater than MEY (such as at MSY) can be used in other sectors of the economy to produce goods and services whose net economic benefits exceed those generated by harvesting the few additional fish beyond MEY. Overcapitalization can also exist in the processing sector, as is the case when too many plants are built to process large quantities of fish in a short time and then lie idle for the remainder of the year, because the fish were harvested all at once in the race which often characterizes open-access fisheries.

Traditional fisheries regulations intended to restrict or reduce effort to the MSY level (often referred to as command-and-control methods) include catch quotas, trip limits, creel or bag limits, gear restrictions, limits on fish size, and time and area closures. These policy instruments can lead to biological improvements in stock levels in the short run, but they do so by effectively raising the cost of harvest at every level. This is equivalent to rotating the total cost curve in Fig. 1-2 up and to the left. While implementing policies like these might raise costs enough that the total cost curve is rotated all the way to the MEY point (E^*), doing this does not increase NEB's. That is, the total revenues still equal total costs at this point, so profits are still zero. In the long run, these methods generally do not sustain even the stock improvements because of the open-access market failure. That is, if the regulations are successful in improving stock levels in the short run, effort will eventually increase to take advantage of the improved stocks and catch rates. As long as profits exist (or TSR>TC), existing fishermen will find ways to increase effort or new vessels will enter the fishery, since the race to fish is not eliminated by these methods. The end result is greater catch and effort and a need to regulate further.

The economically sustainable level of effort and harvest can be achieved when clearly defined and enforceable use rights for fish in the ocean exist. A system of controlled access or the assignment of quasi-property rights corrects for some of the market failure of open-access fisheries by ensuring that the full cost of producing fish is incurred and that the supply curve accurately reflects the true costs of harvest to society. Quasi-property rights refer to a system that gives individuals the incentive to behave as if use rights to a resource exist, without the government actually surrendering its control of the resource. When this happens, the social cost of taking a fish from the ocean is said to be internalized by the fishermen. Giving fishermen the right to harvest a certain amount of fish, without restricting the method,

time, or areas used, allows fishermen the flexibility to harvest how, when, and where they want. That is, when they are guaranteed a right to harvest a specified share of the fish stock, they will do so in the least-cost manner. The race to fish is thus eliminated. Monitoring the catch of individual fishermen and enforcement of catch quotas are key components to the success of any controlled access system. The system can only work if fishermen harvest the amount of fish for which they own rights.

In fisheries, the system of controlled access or quasi-property rights most commonly referred to is the Individual Transferable Quota (ITQ). ITQ's are essentially paper rights to a share of a particular fishery resource. Fishermen can sell their rights, use them by harvesting fish, or choose to hold them without harvesting. The value attributed to the use right, such as that gained by ownership of an ITQ share, represents the resource rent and reflects what fishermen are willing to pay to harvest that amount of the fish stock. Resource rent is the net revenue in excess of normal profits generated by the harvesting of fish that is due to the fish stock itself. In open-access fisheries, rent dissipation is said to occur because the value of the fish stock is not captured.

Two methods that can be used to assess different aspects of the economic consequences of government regulations are economic-impact analysis (EIA) and cost-benefit analysis (CBA). EIA is used primarily to measure how a proposed regulation will affect economic activity in a region or smaller locale in the immediate future. Links among industries are established, and the impacts on indicators such as expenditures, income, and employment in all sectors affected by the regulation are calculated. Purchases of goods and services necessary to harvest and process fish have direct impacts on the economy, whether from the commercial or recreational harvest sector. These purchases create revenues and employment in the vessel construction, labor, and other related support industries. In turn, the economic activity in these industries generates indirect impacts. For example, the purchases of labor, steel, and electronics required to build vessels create additional economic activity not directly associated with fish harvesting or processing. Finally, the incomes generated by these activities finance induced impacts, such as consumer purchases of food, housing, clothing, and entertainment. When a regulation changes the activity of individuals in any of these sectors, the effects "ripple" through the other sectors in the form of changes in expenditures, employment, and income. A good example of how EIA does not measure economic value is a natural disaster. When a hurricane, tornado, or earthquake strikes, there is usually a lot of money spent in the economy to recover from the damages incurred, but it would be hard to argue that society is better off (i.e. that NEB have increased) as a result of the disaster. Another example is an increase in fuel price; while expenditures for recreational fishing would increase, anglers would not necessarily be better off.

Cost-benefit analysis is used to determine whether there are positive net economic benefits from a proposed regulation. CBA is based on measuring and summing all of the costs and benefits associated with the regulation. If the costs of the regulation are less than the benefits (or the NEB are greater than zero), then the regulation is beneficial to society. CBA can also be used to compare the effects of alternative regulations: from the standpoint of economic efficiency, the regulation with the highest NEB is the most efficient and adds the most to the well-being of the Nation. CBA differs from EIA in that it can involve estimating the changes in consumer and producer surplus, rather than expenditures and employment, in all sectors affected by the regulation. In doing so, CBA takes into account whether resources are being put to their best use. In a sense, EIA determines where the gains and losses of the regulation occur by demonstrating how economic activity changes in each sector. CBA determines whether society could be better off from the regulation and whether resources are being efficiently allocated.

An example of the two methodologies may better illustrate the conceptual differences between them. Suppose the black sea bass recreational fishery closes and anglers shift all of their effort to fishing summer flounder. In terms of EIA, it would appear that no losses have occurred; expenditures on recreational fishing have not changed. However, angler consumer surplus (ACS) is reduced, because the opportunity to fish black sea bass is no longer there. We know that this opportunity had value to those anglers because they could have been fishing summer flounder, but chose not to until the black sea bass fishery closed. Summer flounder anglers might also experience a loss in ACS if catch rates fall as a result of the additional

black sea bass anglers now in the fishery. CBA estimates the losses in consumer surplus for those anglers.

Now suppose that instead of switching to the summer flounder fishery, black sea bass anglers decide to spend all of their recreational money on bowling. Again, total expenditures in the economy do not change, but are merely transferred from the recreational fishing industry to the bowling industry. EIA would capture the shift in dollars spent in the economy, while CBA would capture the loss in consumer surplus to those anglers who can no longer fish for black sea bass.

In summary, this chapter has provided some of the basic terms and concepts that are useful for understanding and interpreting the information provided in the following chapters. Familiarity with terms like consumer and producer surplus, net economic benefits, open access, controlled access, market failure, and efficient resource allocation will make this document easier to read. Where possible, the report uses and applies these terms to provide information about the current economic health of the Nation's fisheries and to furnish reasons for trends in the various indicators used to assess health.

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1954. The economic theory of a common property resource. J. Polit. Econ. 62:124-42.

Chapter 2

Overview of the U.S. Fishing Industry

Introduction

NOAA's vision for increasing the Nation's wealth includes maintaining fishery resources over time to provide Americans with both commercial and recreational fishing opportunities and a safe supply of high quality seafood. This vision incorporates both biological and economic sustainability: stock levels maintained at biologically healthy levels; optimal harvest of fish over time, using the least-cost levels of capital, labor, and other resources; and equitable allocation of the harvest between user groups. Information is presented in this overview chapter to help characterize the economic health of U.S. fishery resources at the national level. This chapter describes and interprets some of the major recent trends in the U.S. harvesting, processing, trade, retail, and recreational sectors, and highlights relevant economic issues affecting each sector. It also identifies data needs in each sector that have to be met to enable economic analysis that would be useful in the management process.

At the national level, many U.S. fisheries are characterized by an increasing number of allocation disputes, including those between commercial and recreational fishermen, between various subsets of the commercial harvesting sector, and between the harvest sector and environmental interests. The solutions intended to ensure the biological health of fishery resources while resolving allocation issues typically include imposition of increasingly strict and more complex regulations. As discussed in Chapter 1, these solutions are usually ineffective from the standpoint of economic sustainability of fishery resources or the economic health of the fishing and seafood-related industries. Thus, when possible, this chapter identifies alternative solutions for management that could simultaneously achieve both types of sustainability envisaged by NOAA.

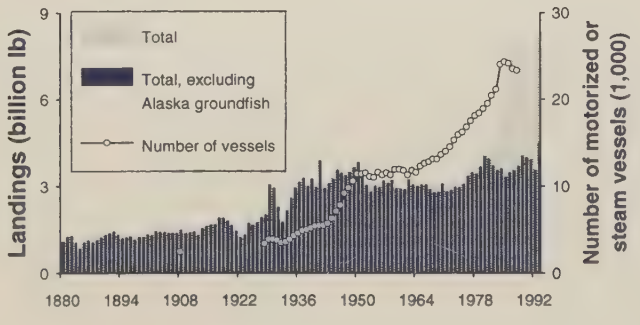


Figure 2-1
U.S. commercial domestic landings of food fish.

The U.S. Commercial Harvesting Sector

Quantity, Ex-vessel Value and Composition of U.S. Landings

The total domestic commercial landings of edible finfish and shellfish since 1880 are shown in Figure 2-1. Once Alaska groundfish landings are subtracted, total U.S. landings have remained fairly stable since World War II. In the past decade, domestic landings of all commercial fishery products have increased fairly steadily, reaching a record high of 10.5 billion pounds in 1993 (Fig. 2-2). Total real revenues from U.S. fishery products reached their peak in 1988. The increase in volume without an equivalent increase in real revenues is due to the fact that increasingly more lower-valued species are being harvested. However, without information on the cost of harvest or consumer surplus, ex-vessel value of landings only yields a measure of the gross revenues of U.S. fishermen, not profits or net economic benefits. Additionally, landings figures only measure how much has been harvested, not how efficiently that harvest was achieved.

Relative to the rest of the fishing nations, the United States was the world's fifth largest pro-

ducer of seafood (by weight) in 1993 (USDOC, 1994), harvesting almost 6% of the world catch, behind China (17%), Peru (8%), Japan (8%), and Chile (6%). Within the United States, the Pacific region's share of total harvest has been increasing over the past 11 years, while its share of total revenues has increased only slightly (Fig. 2-3 and 2-4). This is primarily due to the large harvests of Alaska groundfish, the most important U.S. species group in terms of volume in 1993 but ranked fourth in terms of total gross revenues.

Between 1984 and 1993, total U.S. domestic finfish landings have been significantly greater than shellfish landings, accounting for between 80 and 90% of total volume, while contributing only 48-58% of the total ex-vessel value (Fig. 2-5). Again, the steady increase in finfish landings over time, as well as the downward trend in finfish revenues since 1988 are attributable to the remarkable development of the low unit value Alaska groundfish fishery, as well as concurrent decreases in the harvest of other high-valued finfish.

The ex-vessel revenues and quantity of landings of the ten most valuable U.S. commercial species groups in 1993 are shown in Figure 2-6. Crabs, shrimp, and salmon are the three highest-valued species groups. When ranked against individual species (rather than species groups), walleye, or Alaska pollock, is also first in terms of total revenues. In 1984, pollock was not ranked within even the top fifteen species in terms of volume or value. Of the remaining six species, three are shellfish, which are characterized by high unit values and relatively low landings.

Over time, the progression toward harvest of more lower-valued species is to be expected. In the development of any fishing industry, fishermen will first target those species that will earn the most profits, and eventually transfer effort to increasingly lower-valued species as the higher-valued stocks become harder to catch. Even the best-managed fisheries sector would be characterized by a harvest mix of high- and low-valued fish. A problem only arises when the mix tends too rapidly towards the harvest of lower-valued stocks because of the successive depletion of higher-valued stocks. A fishing sector that harvested all of its fisheries at sustainable levels would yield greater net economic benefits than one that developed, exploited, and ultimately overfished each of its fisheries in turn. Under conditions of open access, the rate of exploitation of all stocks is generally higher than under controlled access fishing, and there is a greater tendency for stocks to exceed the points of economic and biological sustainability.

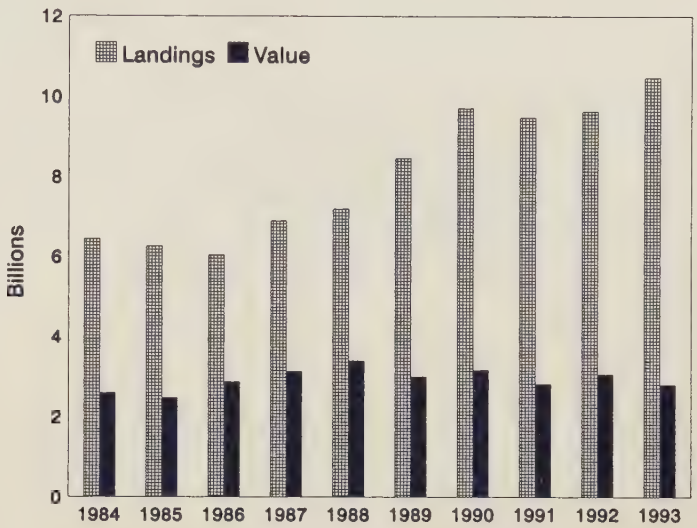


Figure 2-2
Landings and real ex-vessel value of all U.S. commercial fisheries.

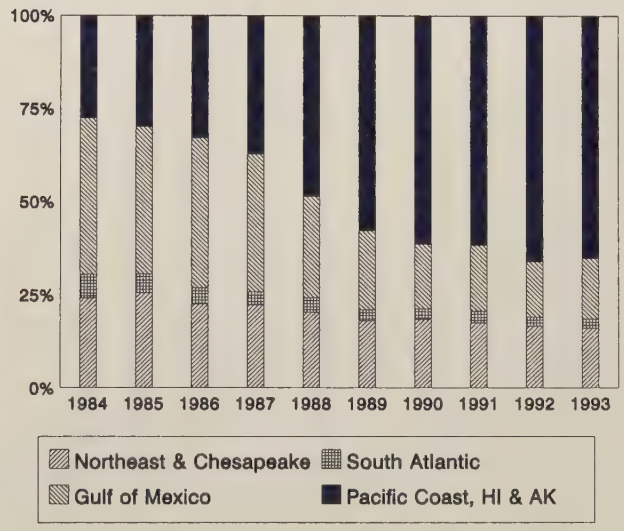


Figure 2-3
Percent of U.S. domestic landings by region.

Effort in U.S. Fisheries

Defining and estimating efficient or cost-effective levels of effort is important for understanding the losses to society from the misallocation of resources such as labor and capital (or the benefits to be gained from proper allocation). Detailed economic analyses of the majority of U.S. fisheries on an individual basis would probably reveal that the amount of effort used is greater than that necessary to harvest the maximum economic yield. That is, most U.S. fisheries can probably be characterized as overcapitalized, with too many vessels, too much gear, and too much time spent at sea harvesting fish at a higher than optimal cost per unit of effort, hurting both consumers and producers.

Evidence exists of the magnitude of economic benefits lost as a result of open access. For example:

- The economic benefits in the New England groundfish fishery could be increased by $150 million annually. To realize these benefits, however, effort would need to be reduced by 70% (Edwards and Murawski, 1993).
- The number of full-time vessels in the Gulf of Mexico shrimp fishery more than doubled between 1966 and 1991 (Fig. 2-7), but annual net revenues per vessel decreased about 75% to approximately $25,000 (in 1990 dollars). Total landings by full-time vessels were virtually unchanged over the time period, with an annual average of about 200 million pounds during 1966-75 and a 250-million-pound average between 1981 and 1991. With a fleet of over 16,000 vessels and boats operating in 1988, it was estimated that one-third of the fleet could harvest the same amount of shrimp; that is, two-thirds of the fleet could be retired, with the capital investment shifted to other sectors of the economy (Ward and Sutinen, 1994).
- Total landings in the Pacific halibut fishery and the length of the open season from 1924 to the present are shown in Figure 2-8. Landings rose rapidly during 1975-93, with a high in 1988, while the length of the season decreased steadily to only a handful of days.
- A study of the Bering Sea pollock fishery estimates that "the catching capacity of vessels ... appears to be double or more the annual quota" and observes that given current market conditions, "...considerable downsizing would be needed to restore profitability in this [Bering Sea/Aleutian Islands pollock fisheries] fleet" (Miller et al.[1]).

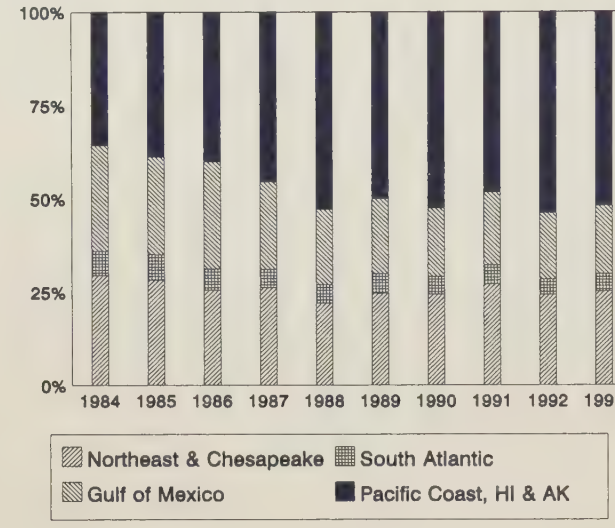


Figure 2-4
Percent of value of U.S. domestic landings by region.

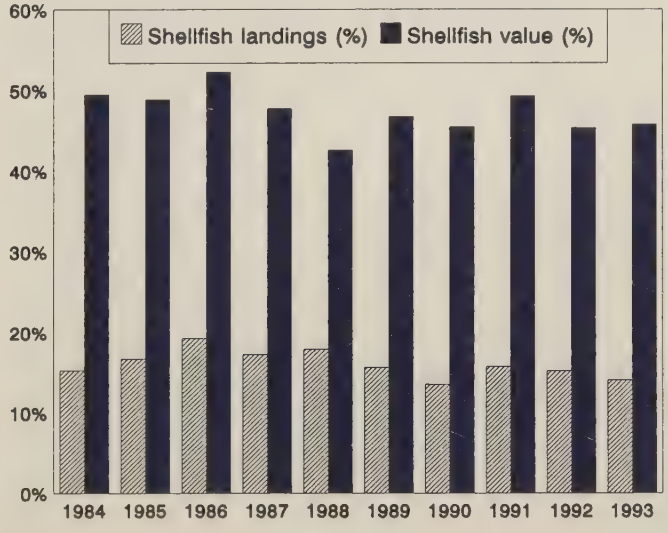


Figure 2-5
Shellfish value and volume as a percentage of total domestic revenues and landings.

[1]Miller, M., D. Lipton, and P. Hooker. 1994. Profile of change: A review of offshore factory trawler operations in the Bering Sea/Aleutian Islands pollock fishery. Report to the National Marine Fisheries Service, 37 p.

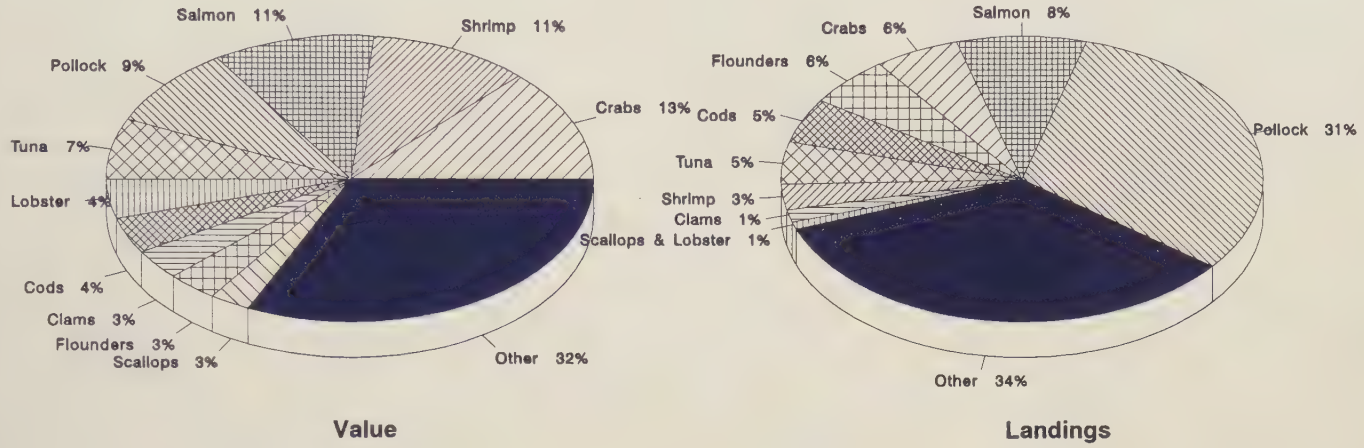


Figure 2-6
Ten highest valued species groups landed by U.S. fishermen in 1993.

- In the New England otter trawl fishery, premium prices are paid for larger haddock; harvest of small, 2-3 year old haddock yields a relatively lower-valued product. Open-access fishing usually results in the harvest of younger, smaller-sized fish. In addition to reducing the reproductive stock by not allowing fish to mature, value is often lost by not delaying harvest until fish have attained a more marketable size. That is, the opportunity cost of leaving fish in the ocean to grow and reproduce is foregone.
- On Georges Bank off New England, the relative abundance of traditionally high-valued cod, haddock, and yellowtail flounder decreased from almost 50% to 14% between 1963 and 1993, while the relative abundance of less commercially valuable skates, spiny dogfish sharks and other elasmobranchs increased from about 40% to more than 75% (Fig. 2-9). Unlimited access to these historically valuable fishing grounds has greatly affected the balance of the ecosystem and, ultimately, the composition of the landings.
- In the Atlantic surf clam fishery, which implemented an ITQ system in 1990, the fleet was reduced by 54% within 2 years; landings per vessel increased while total landings increased slightly. The value of the surf clam resource was estimated to be $57 million in 1992, with a resource rent of over $11 million accruing directly to the surf clam industry (the Northeast regional spotlight article provides a full discussion). Resource rent that was being dissipated before the assignment of use rights by the ITQ system is now being captured directly by the shareholders.

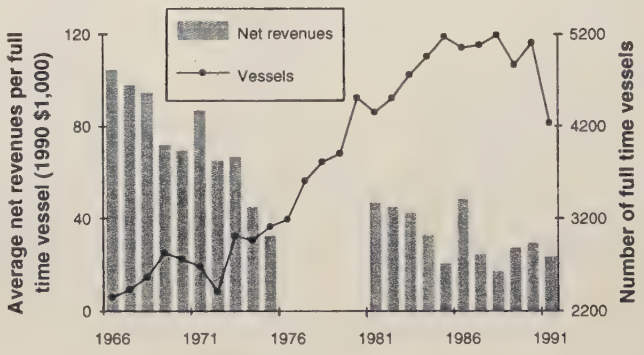


Figure 2-7
Overcapitalization of the profitable Gulf of Mexico U.S. shrimp fishery.

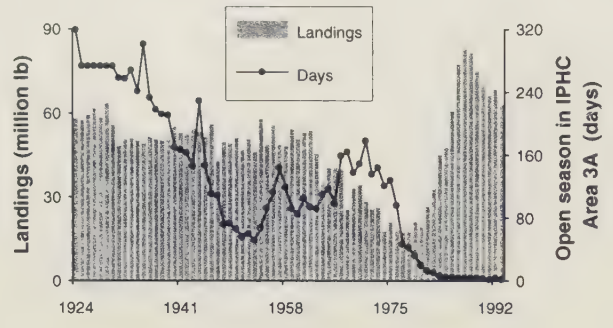


Figure 2-8
Open season in the U.S. Pacific halibut fishery.

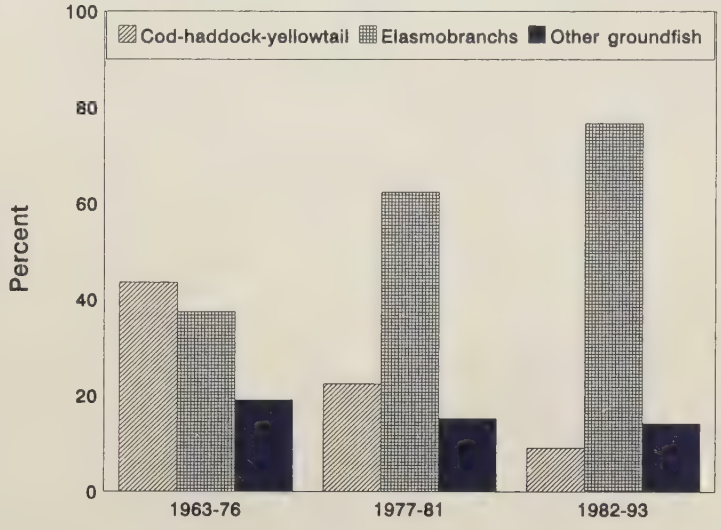


Figure 2-9
Relative abundance of demersal finfish resources on Georges Bank.

- Since implementation of an ITQ system in the Southeast wreckfish fishery in 1992, the number of vessels with wreckfish permits has decreased from 91 in 1991-92 (with 44 vessels reporting catch) to 21 in 1994-95 (with 11 reporting catch); wreckfish prices have increased, total landings are lower but more constant throughout the year, and the value per share is about $10,000, for a total value in the fishery of close to $1 million.

The examples above illustrate the type and magnitude of the losses associated with traditional open-access fisheries management. The gain in net economic benefits (NEB's) that could be achieved by solving the open-access problem and reducing effort in U.S. fisheries is fairly clear.

While fisheries economists and managers generally agree that many U.S. fisheries are overcapitalized, demonstrating this empirically on a systematic basis is difficult. The data necessary to measure or estimate the degree of overcapitalization and the subsequent rent dissipation are often not available or vary from fishery to fishery. For example, to measure economic rent requires: 1) detailed information on the number of vessels, 2) the number and types of gear used by each vessel, 3) the number of days at sea spent by individual vessel, and 4) the costs incurred by vessels. (Table 2-1 provides a more complete list of the status of necessary data elements and analyses.) Funds are unavailable or insufficient to collect these data. Moreover, even where funds are available, there is a widespread reluctance from participants to provide these data. Where data were available, the regional chapters in this report document the losses in NEB's from excessive effort in their fisheries or gains in NEB's from programs that effectively reduced effort.

The U.S. Fishing Fleet

The U.S. fishing fleet is quite diverse in terms of sizes and gear types. Vessel sizes and types vary significantly between fisheries as well as between geographic areas. One consequence of the size and diversity of the harvest sector is that management of all U.S. fisheries with a single policy is not feasible. Even individual fleets are quite diverse, and each fishery has unique biological, economic, and sociological characteristics that make broad-based policy impractical. On the other hand, regulation on a fishery-by-fishery basis is not practical or effective. Vessels are extremely mobile and are often able to change gear types quite readily. In addition, retiring vessels from fishing altogether is often difficult; once a vessel is built and equipped for fishing, few alternative uses exist for it. This provides incentive for vessels to transfer effort from one fishery or geographic location to another, rather than leave fishing altogether, when regulations become binding. When vessels shift effort to open-access fisheries or to those regulated with traditional command-and-control methods, the new vessels may impose stock and/or crowding externalities on existing

vessels. When controlled access systems are in place, these externalities are taken into account when fishermen decide whether or not to enter a new fishery. Fishermen would only shift effort to another fishery if it was worth the cost of purchasing the right to harvest in that fishery. Thus, management systems that take into account the potential transfer of effort, and provide the correct incentives and signals for entry and exit of vessels and fishermen, are important for ensuring that effort reductions in one fishery do not exacerbate conditions in other fisheries.

Disappointingly, the most recent complete data available at the national level on U.S. commercial fishing vessels are from 1987. In that year, there were about 23,000 vessels in operation, accounting for 3% of the world's fishing vessels, and totaling almost 1,000,000 gross registered tons (GRT). The Food and Agriculture Organization (FAO) of the United Nations estimates that the U.S. fleet was the world's fourth largest in 1987 in terms of total GRT (4%), following the former U.S.S.R., China, and Japan (FAO, 1991). Fishing vessels from these four countries comprised 70% of the vessels operated by 50 principal fishing nations and 60% of the total GRT.

Figure 2-10 demonstrates the dramatic rise in the number of commercial steam or motor vessels (5 net tons or larger) over the period 1880-1987 and, combined with the landings exhibited in Figure 2-1, suggests that increasingly more vessels are catching roughly the same amount of fish. Furthermore, technological advances over this time period have greatly increased the efficiency of these vessels.

Table 2-1
Data needs and economic information for harvesting sector.

Item	Data/estimates available: Routinely for all FMP's	Routinely for some FMP's	By special study	Not available
Ex-vessel landings, revenues and prices, by species, by vessel	✔			
Variable and fixed costs of production, by vessel			✔	
Bycatch volume and type, by fishery		✔		
Current number of vessels, by fishery and gear type		✔		
Optimal number of vessels, by fishery				✔
Physical characteristics of vessels (gross registered tons, age, etc.)		✔		
Economic/financial characteristics of vessels (cost of construction, purchase price, current market value, etc.)			✔	
Season length, by fishery	✔			
Number of days fished, by vessel		✔		
Number of full- and part-time fishermen, by fishery		✔		
Estimated landings and prices at optimal level of effort, by fishery			✔	
Economic values (i.e., producer surplus and profits) by fishery, at current and optimal effort levels			✔	
Market value of shares and number of shares, where controlled access systems are implemented			✔	
Socioeconomic characteristics of commercial fishermen			✔	
Costs of administration, monitoring and enforcement of regulation, by FMP				✔

Technological Development and Effort

Technological advances have played an important role in the development of U.S. fisheries, particularly in the harvesting sector, but also in the way seafood is processed, distributed, and marketed. The U.S. fleet evolved from mainly sailing vessels in the late 1800's, to steamers and schooners with auxiliary gasoline-powered engines in the early 1900's, and finally to an almost complete conversion to diesel-powered vessels by the 1930's. Concomitant increases in size and speed allowed vessels to fish in ever more distant waters. Sophisticated gear types were available early on: purse seiners were in use in Alaska by 1870, followed by longliners in 1885; otter trawl technology was introduced to groundfish and shrimp fisheries on all coasts during the early 1900's. Great Britain's F/V *Fairtry* launched the age of factory ships in 1954; scores were pulse-fishing herring, haddock, halibut, and salmon from traditional U.S. fishing grounds by the late 1960's.

Other significant inventions or advancements that helped the development of the harvest sector include: onboard refrigeration, the Puretic power block for seine retrieval, double trawls, durable nylon and synthetic fiber for nets and seines, sophisticated electronics for navigation and location of fishing grounds and fish, and seaplanes and helicopters to locate schools of fish.

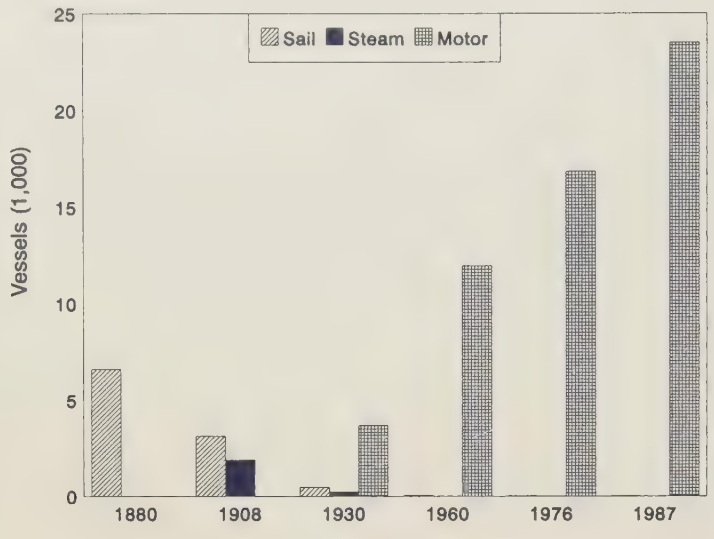
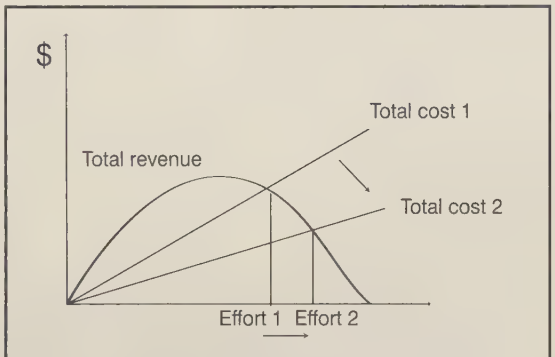


Figure 2-10
Number of U.S. commercial fishing vessels.



Technological improvement leads to lower unit costs, higher open-access fishing effort, zero rents, and lower catch.

Over time, these technological advances and innovations made it possible and affordable for fishermen to harvest more fish more effectively. With harvests essentially unfettered by management, technology developments accelerated the rate at which stocks could be depleted. Without incentives to leave fish stocks unharvested, the net economic benefits that should have arisen from the fishermen's use of technology (as a result of lower costs) were instead dissipated by the depletion of stocks made possible by the technology. While Figure 2-10 demonstrates the evolution of the U.S. fishing fleet in terms of absolute numbers, it hardly reveals the enormous gains in fishing power afforded by technology and ingenuity during the 20th century. Despite tremendous changes in technology, total domestic commercial harvest (excluding Alaska groundfish) has increased only marginally since World War II (Fig. 2-1).

Management of U.S. Fisheries

Concern for the sustainability of fish resources was evident as early as 1871, when Congress wrote that "... the most valuable food fishes of the coast and the lakes of the U.S. are rapidly diminishing in number, to the public injury, and so as materially to affect the interests of trade an[d] commerce...." However, it was not until 1976, when the Magnuson Fishery Conservation and Management Act (MFCMA) was implemented, that the Federal government was awarded responsibility for actively managing fish resources and fisheries. The MFCMA expanded the Federal role in fisheries to include management of resources from 3 to 200 miles off the coast for most species and beyond 200 miles for anadromous species such as salmon.[2] However, Congress has been equivocal about the importance of economic efficiency as a goal for fisheries management. For example, National Standard 5 states:

"Conservation and management measures shall, where practicable, promote efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose."

Prior to the MFCMA, the Federal government fisheries management role was mostly limited to fleet subsidization and research, and to negotiating trade policy and many international agreements and treaties on behalf of the fishing industry.[3] For example, a number of Federal programs actively encouraged the development of the fishing industry:

- The 1964 Amendment to the Fishing Fleet Improvement Act financed up to 50% of vessel construction costs.
- The 1969 Fishermen's Protection Act defrayed the costs of foreign seizure of U.S. vessels.
- The 1970 Fishing Vessel Construction Fund Program deferred payment of Federal in-

[2]Highly migratory species (tunas, sharks, and other billfishes) were included in a 1990 amendment to the Magnuson Act.

[3]Exceptions to this generalization include the Sponge Act of 1906 which prohibited sponge harvest in the Gulf of Mexico or Strait of Florida by divers during May-September and regulations in Alaska's salmon fisheries.

come taxes provided that the money was used to construct or reconstruct a vessel.

- The 1973 Fishing Fleet Vessel Obligation Guarantee Program financed up to 87.5% of the cost of construction, reconstruction, or reconditioning of fishing vessel and shoreside facilities.[4]

The Federal government has also sponsored much scientific, gear, and marketing research, supported by the Dingell-Johnson Act of 1950 and Wallop-Breaux Amendments, the Saltonstall-Kennedy Act of 1954, and the Commercial Fisheries Research and Development Act of 1964. Research conducted with these funds has primarily been aimed at promoting development of the fishing industry.

The United States is not the only country to encourage development of its domestic fisheries. The Food and Agricultural Organization estimates that the total value of the world's marine catch is approximately $70 billion per year while total variable costs are approximately $124 billion per year (FAO, 1993). Various subsidies to fishermen are hypothesized to make up the difference between revenues and costs. The need to subsidize fishermen to help them stay in business is one indication that fisheries are not economically sustainable.

In terms of fisheries management objectives since implementation of the MFCMA, achievement of maximum sustainable yield has been the principal goal. A patchwork of legislation and subsequent regulations, centered on complicated and sometimes conflicting gear restrictions, quotas, trip limits, and time and area closures, has been the result. These effort control management strategies have been largely ineffective, often encouraging inefficient and excessive use of effort and capital of existing vessels, and in some cases, promoting and subsidizing further entry of new vessels. As discussed in Chapter 1, these "command-and-control" measures may achieve short-run stock improvements, but in the long-run they generally are not successful at reducing effort. Despite early recognition of the potential for overfishing in the United States, the actions taken to control harvests from U.S. waters have often been ineffective from the standpoint of both biological and economic sustainability. Figure 2-11 shows the landings for six fisheries from 1837-1993. The profiles of these six are strikingly similar and are probably representative of the pattern of discovery, development, and exploitation in a number of fisheries.

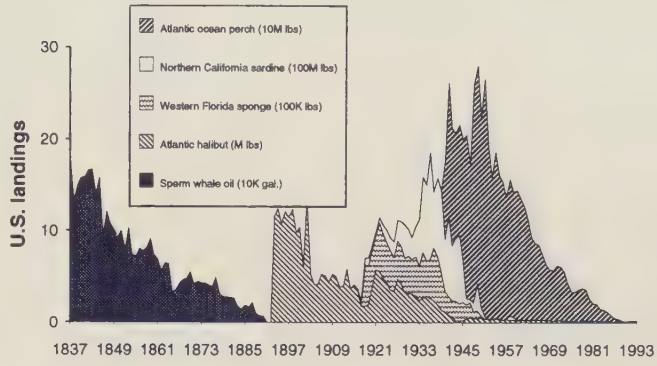

Atlantic ocean perch (10M lbs)
Northern California sardine (100M lbs)
Western Florida sponge (100K lbs)
Atlantic halibut (M lbs)
Sperm whale oil (10K gal.)
U.S. landings
30
20
10
0
1837 1849 1861 1873 1885 1897 1909 1921 1933 1945 1957 1969 1981 1993

Figure 2-11
Fish resources are discovered, exploited, and depleted in open-access fisheries.

A majority of U.S. fisheries have been "diagnosed" by NMFS biologists as operating at or above long-term potential yield, or maximum sustainable yield: 83% of the U.S. fishery resources which have been assessed are classified as over- or fully utilized from a biological standpoint (USDOC, 1993b). Since most fisheries are still characterized by open-access, it seems fairly safe to suggest that the number of U.S. fisheries operating near the efficient point of effort, or harvesting using least-cost methods, is quite small (see Chapter 1 for definitions and graphical representation of maximum sustainable and maximum economic yield). While this statement is based on a highly oversimplified model, it perhaps offers some insight into the extent to which U.S. fisheries might be operating at excessive effort and harvest levels. Many would agree that what Higgs (1982) reported for the Washington salmon fishery holds for the majority of U.S. fisheries:

> "Today, from a comprehensive point of view, the Washington salmon fishery almost certainly makes a negative contribution to net national product. The opportunity costs of the socially unnecessary resources employed here, plus the socially unnecessary costs of governmental research, management, and regulation, are greater than the total value added by all the capital and labor employed in the fishery."

For U.S. fisheries to make positive net contributions to the economy they must operate closer

[4]This act was intended to make U.S.-built vessels as affordable as foreign-built vessels would be if not for a 1973 embargo.

to or at economically sustainable levels. This requires the establishment, implementation, and enforcement of management systems that eliminate the market failure of open-access in fisheries. In systems with catch rights, for example, fishermen own the right to annually harvest a known amount of the fish stock. Fishermen can buy from or sell rights to others, until they hold rights to harvest exactly as much fish as is profitable for them. The least profitable fishermen would probably sell their rights to fish and exit the fishery. The most profitable fishermen would remain in the fishery, using cost-effective methods to fish; society would be better off because the right amounts of capital, labor and other inputs would be used in the harvest. By owning the right to a known portion of the stock, the remaining fishermen can operate when and where they like; the need to "race to fish" is eliminated because their share of harvest is guaranteed. Harvest can be postponed until later in the season, when fish are bigger and prices higher, and can be spread more evenly throughout the season. The incentive to fish under poor or dangerous weather conditions is reduced.

Such systems can be costly to implement, at least initially, and require a strong enforcement presence. The catch of each fisherman must be monitored to ensure that he catches only the amount to which he owns the right. If he exceeds his quota, he reduces the amount of fish available for other fishermen; the "race to fish" is reintroduced if fishermen believe that the amount of fish they are entitled to is being taken illegally by others. Despite potentially high "start-up" costs associated with these systems, in the long run, their implementation is the only way to regain the resource rent dissipated by open access and to ensure that the optimal amount of capital is invested in fisheries. The benefits to society will outweigh the costs of implementation and enforcement in most cases.

Managing for economic sustainability does not affect only commercial fisheries. One of the biggest challenges currently facing fisheries managers is the allocation of limited fish stocks between commercial and recreational fishermen. Central to the allocation process and embodied in Federal laws and regulations are recognition of the net economic benefits to both user groups from use of the resource as well as the impact of each group on the resource. The MFCMA was designed, in part, to enhance the economic value that all Americans derive from their publicly owned fish stocks. The Act promotes efficiency in the utilization of management measures and requires management measures to minimize costs (Sections 301(a)(5) and 301(a)(7)). One of the primary objectives of the MFCMA is to optimize the use of fish for food and recreation to provide the greatest overall benefit to the Nation (Section 301(b)(6)). The greatest net economic benefits are achieved by allocating total allowable catch such that fish are available to those who put them to society's highest-valued use. In other words, additional units of a fish stock would be allocated to the user generating the greatest net economic benefit with those units, whether recreational, commercial, or other, until the marginal net economic benefits are equal for all user groups.

The U.S. Seafood Processing Sector

The processing and wholesale sectors are an integral part of the seafood industry, transforming domestically harvested and imported fishery products and delivering them to the final consumers. The primary processing sector includes firms that purchase the raw product from harvesters or importers and transform it into a final product or deliver intermediate products to the final producers; the primary wholesaling sector refers to those firms involved in an initial phase of distribution of the product, delivering products to processors or secondary wholesalers. The secondary wholesaling sector covers those firms that distribute the final processed products to the retail sector.

As in the harvest sector, technological developments advanced the processing and distribution of seafood. Cold storage and freezing plants used to store excess harvests were established as early as 1892, and they proliferated throughout the 20th century. The first distant-water cold storage plant was built in Costa Rica in 1936, allowing vessels to offload fish far from domestic ports. The canning process developed in France in the early 1800's found a ready use by 1878 in Alaska salmon fisheries and by 1900 in California's tuna fishery. Efficient methods for filleting and packaging fish were introduced during the early 1920's and continued to advance; today the seafood processing and marketing sector is a multi-billion-dollar industry.

Using NMFS Annual Survey data[5], Figure 2-12 shows the total number of U.S. processing and wholesaling plants from 1984 to 1993, as well as the total volume and value processed. While the overall number of processing plants remained fairly constant from 1982 to 1988, and has since risen, Figure 2-13 reveals that the number of plants entering and exiting the industry each year is not inconsequential. The sharp rise in entrants during 1988-89 is due to the initiation of reporting by Alaska and California plants, and some entry and exit is due to recoding, as discussed in footnote 4. However, the figure suggests that this sector is quite dynamic.

The total annual employment in processing plants peaked in 1991, while total employment in wholesale plants peaked in 1989 (Fig. 2-14). The average number of employees per processing and wholesaling plant declined after reaching high levels in 1986-87 (Fig. 2-15). Volume and value of processed output per employee rose during 1988-93, as per plant volume remained essentially unchanged and per plant value declined (Fig. 2-16). This could be due to technological advances that reduce reliance on labor, as well as exit of larger firms from the industry.

The processing sector is dependent on the harvest sector, and is subject to the seasonal variation inherent in most fisheries. Many firms compensate by diversifying, processing more than one species or product, but may still cease production for parts of the year. Others just operate seasonally. A potential benefit of management plans that smooth harvesting patterns, such as controlled access systems, would be the added scope for processing firms to smooth their production and delivery of fresh, high quality products. Estimation of the impacts on processors requires data not currently available. (Table 2-2 provides a list of data needs and analyses.) Economic losses in value due to lower fish quality may be substantial

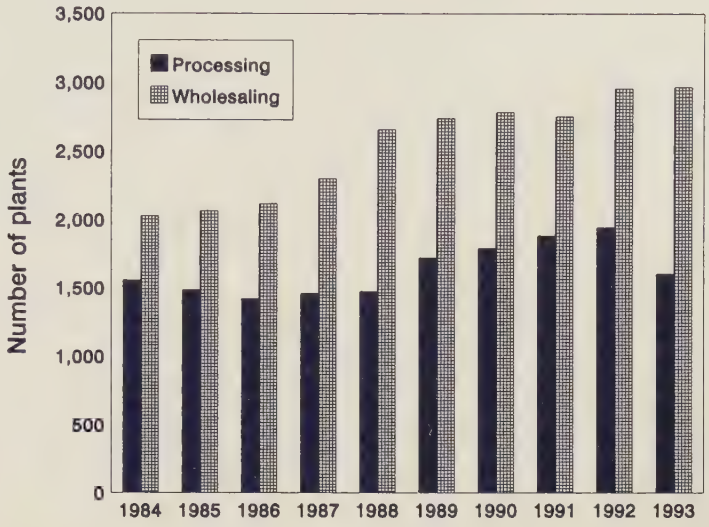


Figure 2-12
Number of U.S. processing and wholesaling plants.

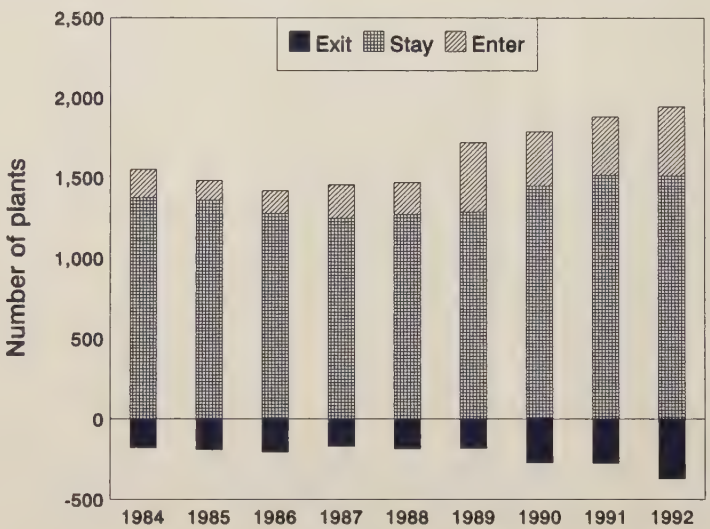


Figure 2-13
Number of U.S. processing plants entering, exiting, and staying in the industry.

(Wilen and Homans[6]). In fisheries with a catch quota or in simple limited entry fisheries, fishermen race to harvest fish before the quota is filled, often forsaking quality for quantity. For example, historically a high percentage of the U.S. Pacific halibut catch has been landed without being gut-

[5]Some anomalies exist in the NMFS data. The NMFS definition of processing was changed in 1989 to include "dressed" product if the product was intended for export or was being delivered directly to final consumers. This category was previously excluded to eliminate the double counting that might arise when dressed product was delivered to another firm for further processing. Prior to 1989, Alaska processing plants were not surveyed by NMFS; the number of Alaska plants was estimated from state production records. California plants were not extensively surveyed prior to 1986. There are some inconsistencies in the recording of plant identification codes that make it difficult to track individual plants over time.

[6]Wilen, J. E., and F. R. Homans. 1993. Marketing losses in regulated open-access fisheries. Univ. Calif., Davis. Unpubl. manuscr., 8 p.

ted or iced, and processing has been delayed by landing gluts, both of which can reduce product quality. In the British Columbia halibut fishery, 42% of the halibut was marketed fresh prior to the implementation of individual vessel quotas (IVQ's) in 1991; since implementation, 94% has been marketed fresh. The average price per pound increased $0.68 after IVQ's were implemented. And notably, the 1993 price of Pacific halibut landed by U.S. fishermen is about $1/lb less than that landed by Canadian fishermen (Casey et al, 1995).

While thus far overcapitalization has been discussed in terms of the harvest sector, overcapitalization can also take place on land. In some fisheries, a large percentage of harvested fish needs further processing (as opposed to being primarily delivered fresh to markets) or a substantial volume of fish is harvested in a short time period (due, for example, to restricted harvest seasons or to catch quotas). In both cases, the high product volume gives firms an incentive to build larger, more capital-intensive processing plants than are necessary for much of the year. This, in turn, increases the cost of building a plant, which keeps potential competitors out through high entry costs, sometimes limiting the number of firms to just a few. As discussed in the "Primer" chapter, a market where there are a few buyers (processors) and many sellers (fishermen) is an oligopsony. In an oligopsony, the buyers can often influence, and will generally reduce, the price paid to sellers for their product. The producer surplus of fishermen is reduced when the processing sector is oligopsonistic.

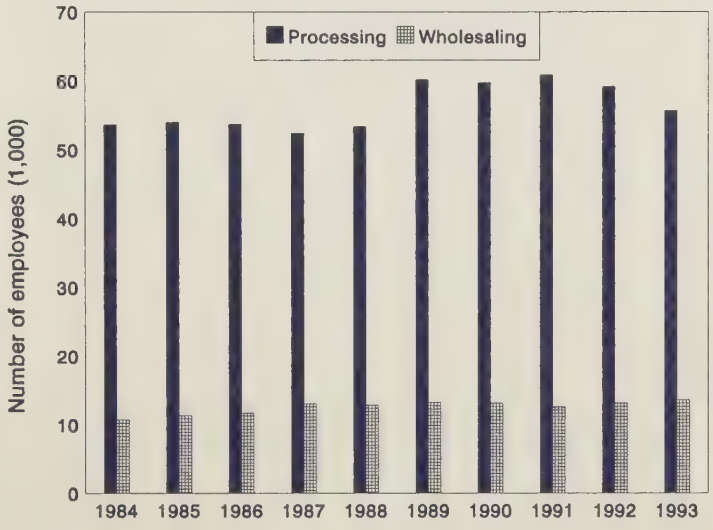


Figure 2-14
Number of employees in U.S. processing and wholesaling plants.

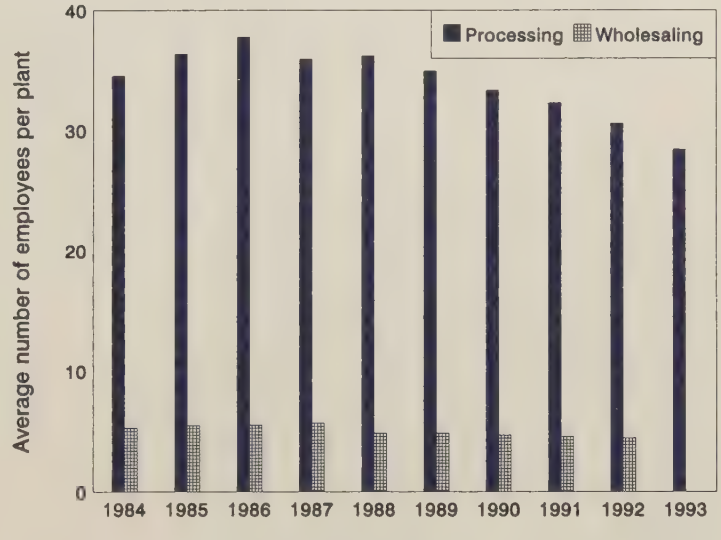


Figure 2-15
Average number of employees per processing and wholesaling plant.

Processing and Wholesale Sector Data

Data on the processing sector are available from a few sources. NMFS conducts an Annual Survey of Processors that contains information on the annual volume and value of processed product by processing plant, as well as annual and seasonal employment by both processing and wholesaling plants. Provision of these data are voluntary; however, approximately 95% of all processing and wholesaling firms are believed to be represented in the data set. The Food and Drug Administration (FDA) also surveys processing plants, but uses a different definition of processing; hence, there is some discrepancy between the number of firms included in the NMFS and FDA surveys. Specifically, the FDA counts a firm as a seafood processor if it makes any changes to the product, including the "dressing" of seafood. As such, the FDA survey includes supermarket chains and cottage industries not captured in the NMFS survey. Some information on processed seafood products can also be gleaned from the Bureau of Census, which maintains aggregate industry information based on the Standard Industrial Classification system.

The U.S. Seafood Trade Sector

The United States plays a major role in the international seafood market, importing and exporting billions of dollars worth of seafood each year. The United States is the world's primary exporter of seafood products in terms of value, and is the second largest importer (USDOC, 1994), trailing only Japan (Fig. 2-17 and 2-18). Developing country harvests have increased at a much higher rate in the last twenty years than in developed countries (FAO, 1993). As a consequence, all ten of the leading seafood importers are developed countries, while four of the leading seafood exporters are developing countries. Japan is clearly the primary consumer of U.S. fishery products (Fig. 2-19). In 1993, 62% by value (58% by volume) of all U.S. edible seafood products, valued at $2 billion, were exported to Japan. This was almost five times as much as was sold to Canada, the next most significant importer of U.S. product.

Exports

The U.S. seafood trade market in part reflects conditions in its domestic fisheries. The real value of U.S. exports reached a record of almost $6 billion in 1992 (Fig. 2-20). The large jump between 1988 and 1989 reflects the elimination of joint ventures in Federal waters in 1989, which effectively ended foreign directed fishing in the U.S. EEZ. Concurrently, an international market developed for pollock roe and low unit-value, high-volume surimi supplied by U.S. processors. Salmon, crabs, caviar roe, and surimi comprised the United States' four most valuable export products in 1993, contributing approximately 61% of the total value but only 49% of the total volume of seafood products exported.

Three of the top ten exports are high-valued, low-volume shellfish products (crabs and crabmeat, shrimp, and lobsters), with relatively high prices per pound. The other seven products are finfish or finfish-related products. Salmon is by far the most valuable export product, comprising almost 25% of the total value of exports, even though salmon prices have declined over time due to a series of record or high harvests and because of the world-wide growth in salmon culture. The remaining finfish export products, with the exception of caviar and roe, can be characterized as

Table 2-2
Data needs and economic information for processing/wholesale sector.

Item	Coverage of data/estimates: Complete	Partial	By special study
Revenues and volume of processed product, by firm	✔		
Variable costs (including wages) and fixed costs of production, by firm			✔
Number and size of plants and/or processing vessels, by fishery or product		✔	
Number of full- and part-time employees by firm	✔		
Economic values (i.e., producer surplus and profits) by product			✔
Utilization rates, by firm			✔

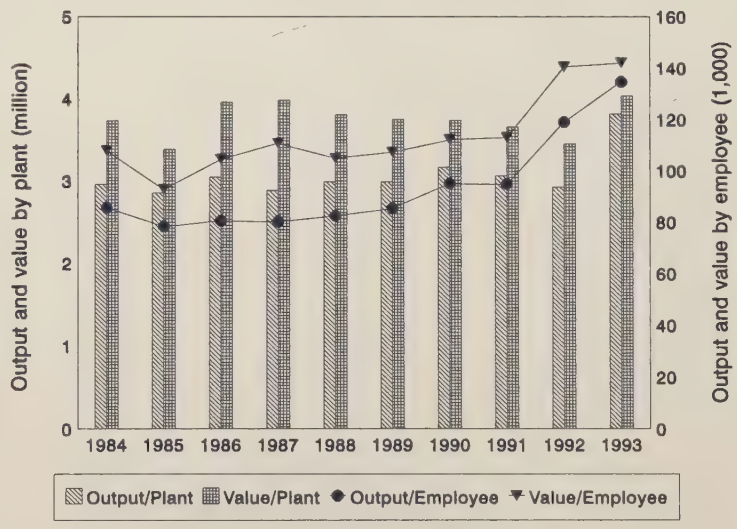
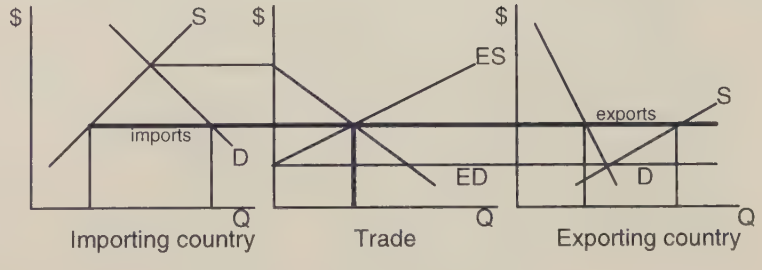


Figure 2-16
Average volume and real value of processed product by plant and by employee.



Excess demand, ED, [or excess supply, ES], is generated from prices higher [lower] than the equilibrium price in the importing [exporting] country. Trade occurs at a price somewhere between the prices in the two trading countries (equal price save for transportation/transaction costs).

high volume but low unit-value. Of the top ten products exported, seven originate predominantly in the Pacific Northwest and Alaska, consistent with the dominance of those fisheries at the harvest level.

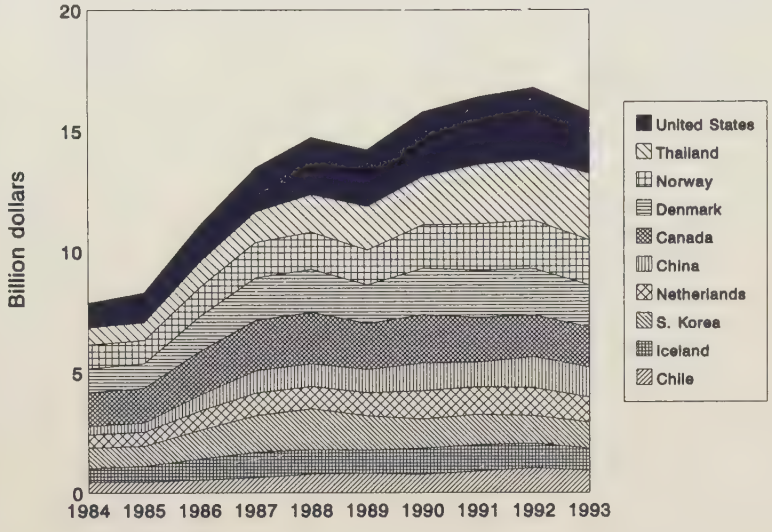


Figure 2-17
Real value of exports by leading exporting countries, for seven fishery commodity groups.

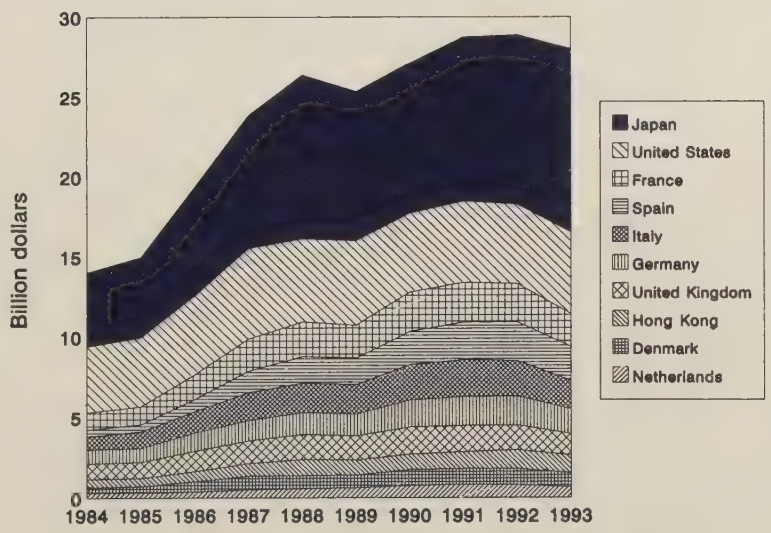


Figure 2-18
Real value of imports by leading importing countries, for seven fishery commodity groups.

Imports

Four of the ten most valuable edible seafood products imported by the United States in 1993 are high-valued shellfish (shrimp, lobsters, scallops, and crabs); domestic harvests of those species has either fallen or remained steady in recent years. Shrimp was by far the most valuable imported product in 1993; at $2.2 billion dollars, the value of shrimp was almost four times as high as that of tuna, the second highest-valued import. Shrimp has become such an important commodity that the Minneapolis Grain Exchange established a futures market for shrimp in 1993.

Trade and Efficiency

Economic efficiency in trade relies on the concept of comparative advantage: under free markets, a country produces goods for which it has lower relative costs of production and then trades with other countries to obtain those other goods that are produced more cheaply elsewhere. Common barriers to trade are quotas and tariffs, which are intended to provide an advantage to domestically produced goods by raising the price of imported goods. The consequence is generally a lower volume of trade and higher prices to consumers and domestic producers than would be obtained otherwise; resources are misallocated, and incomes and consumer surplus are reduced. Table 2-3 provides the status of data needs and analyses necessary to evaluate the costs and benefits of trade policies on the economy.

Trade in seafood can be hampered by the use of "nontariff" trade barriers, also intended to protect domestic interests, including human health. Nontariff trade barriers include the enforcement of minimum quality standards (e.g. in concentration levels of certain metals or in the methods of handling seafood), imposition of import quotas, requirement of "import licenses," or restrictions on the method of harvest or production. Environmental interests are often enmeshed in trade issues as well and can provide effective barriers to trade. Perhaps the most publicized example of this is the United States' use of trade embargoes against Mexican-caught tuna due to the high incidence of dolphin bycatch by Mexican tuna vessels. In this case, the General Agreement on Tariffs and Trade (GATT, described below) ruled that the United States was imposing unfair trade conditions on

Mexican yellowfin tuna products by requiring that the byproducts from tuna production be the same in both countries. (The West coast regional spotlight article describes the dolphin-safe policy imposed on U.S. tuna fishermen.) A similar conflict exists in the Mexican and U.S. shrimp fisheries; U.S. fishermen are now required to use Turtle Excluding Devices (TED's) that allow sea turtles to escape shrimp nets and thereby avoid drowning, while the Mexican shrimp fleet is currently required only to show progress towards implementation of TED's.

Free Trade Agreements

Efforts to reduce barriers to trade are addressed by GATT and the North American Free Trade Agreement (NAFTA), both implemented in 1994. NAFTA is intended to reduce or eliminate trade barriers between Canada, Mexico, and the United States, while the GATT is a multinational agreement. Canada and Mexico are relatively substantial seafood trading partners with the United States. Pre-NAFTA tariffs on seafood exported to Mexico from the United States were between 0 and 20% while most seafood products imported from Mexico and Canada faced no tariffs. Under NAFTA, tariffs are either eliminated immediately or are scheduled to be phased out completely within 15 years. In addition, provisions are made to ensure that minimum quality standards cannot be used to preclude trade, while ensuring that existing health and safety standards are not jeopardized.

A 1993 Department of Commerce report states that seafood is one of the "best sales prospects" in Mexico (USDOC, 1993a). The opening of shipping lines (railroad and highway) between Mexico and the United States will allow faster and more efficient delivery of fresh and frozen seafood between the two countries. The reduction of existing trade barriers will make U.S.-produced seafood more competitive in Mexican markets, and it should ultimately increase the supply of seafood exported to Mexico. As Mexican incomes and population continue to rise, the demand for seafood, particularly processed U.S. seafoods, is expected to rise. Consequently, for those fisheries with rational fisheries management programs in place, the producer surplus of U.S. harvesters and processors should increase.

Retail Demand for Seafood

The ultimate destination of harvested and processed fish is the seafood consumer. Consumer demand essentially drives the fishing industry; consumers' preferences and their willingness to pay for fish are major determinants of which species are caught and sold in the marketplace. Socioeconomic forces in the United States over time have undoubtedly influenced the current

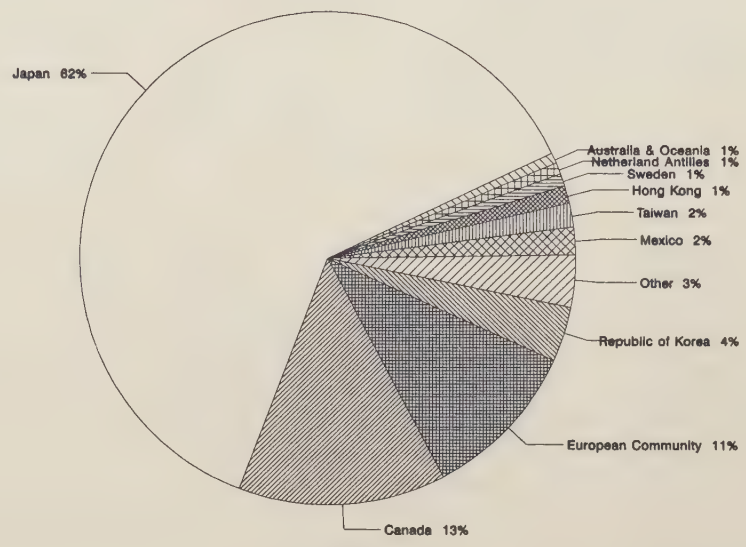


Figure 2-19
Top ten countries of destination for U.S. seafood exports in 1993, by percentage of value. (Total value of edible exports = $3.1 billion.)

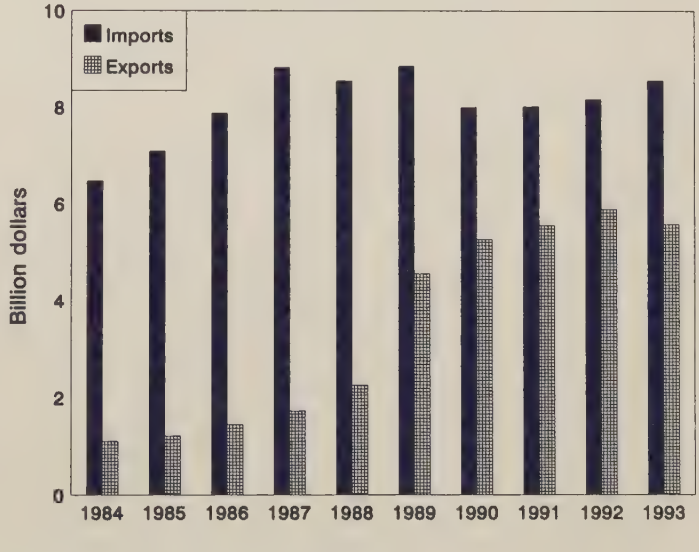


Figure 2-20
Real value of imports and exports (edible and nonedible products).

Table 2-3
Data needs and economic information for trade sector.

Item	Coverage of data/estimates: Complete	Partial	By special study
Volume and value of imports, by fishery product and country of origin	✔		
Volume and value of exports, by fishery product and country of destination	✔		
Identification of tariff and nontariff trade barriers		✔	
Economic value of losses (i.e., lost consumer and producer surplus) attributable to trade barriers			✔

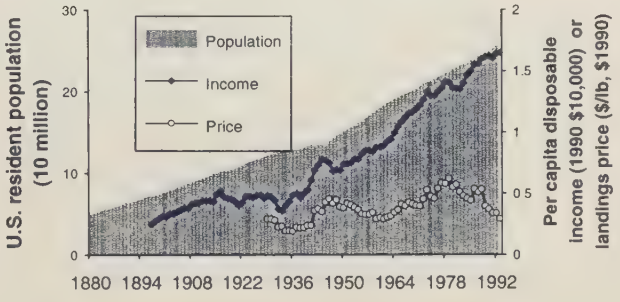


Figure 2-21
Socioeconomic trends.

makeup of the seafood industry. Population, real per capita income and ex-vessel prices are three factors that economic theory suggests should explain the aggregate demand for seafood. The U.S. population has grown at a rate of about 1% per year over the past 40 years (Fig. 2-21). More consumers translates to more total seafood demanded. Economic theory also predicts that the quantity demanded of a "good" increases as income rises. Real per capita income in the United States has increased every year and will likely continue to do so, indicating that per capita consumption of seafood should also continue to rise.

The early 1980's ushered in an era of increased public awareness of the health benefits associated with consuming seafood; these benefits were widely publicized by the industry and the media and were even promoted by the Federal government. As consumers became aware of these health benefits, their preferences may have shifted away from beef and chicken towards seafood, resulting in greater seafood consumption than would otherwise have occurred. That is, it is possible that preferences for seafood have been changing over time (i.e. the demand curve for seafood may have shifted upward). Changes in technology in the harvest and processing sectors over time increased the availability of fresh and frozen seafood to consumers, also possibly serving to shift the demand for seafood by making it more palatable as well as accessible. It is apparent that both demographic and socioeconomic changes in the United States may continue to contribute to further increases in seafood consumption. This provides fishermen with incentives to search for new ways to increase supply.

An understanding of the responsiveness of consumers to changes in prices (price elasticity) and quality, their willingness to substitute among various seafood products and other protein sources, and their readiness to purchase imported products is critical for a number of reasons:

1) Regulations imposed on U.S. fisheries affect the quantity of seafood harvested and the price paid for it. Consumer responsiveness to price changes plays a large role in determining the impact of a regulation on fishermen. If consumers can substitute one fishery product for another fairly easily, demand is more likely to be price elastic; when the price of one fish product increases, consumers will purchase a different product if they perceive that product to be a close substitute for the original one. If demand for a particular product is relatively price elastic then a regulation that restricts supply will reduce producer surplus more than if demand were price inelastic. Thus, understanding consumer demand for seafood can help assess whether proposed regulations will have the intended effect on commercial fishermen.

2) A full accounting of the impacts of a regulation, to assess the net economic benefits, includes the changes in consumer surplus as well as producer surplus. Models of consumer behavior to estimate the demand curve for seafood products are critical for obtaining reliable estimates of consumer surplus and hence, total net economic benefits.

3) A basic understanding of consumer demand for seafood is necessary for predicting how consumers react to both positive and negative information. For example, as the seafood safety issue becomes increasingly important, models of retail demand for seafood could assist government regulators and the industry in understanding how con-

sumers respond to perceived and actual risks, and how they might be influenced in the marketplace. From a public policy standpoint, this is especially important for determining how best to minimize consumer risk from seafood consumption and for determining potential losses in consumer surplus due to contaminated seafood (e.g. from oil spills or outbreaks of diseases in harvest areas). From an industry standpoint, models of retail demand yield information on which advertising strategies might be most effective in inducing consumers to purchase more seafood (or to convince new consumers to try seafood). For example, local supermarket advertising of price reductions might be more effective at stimulating demand than generic advertising of all seafood by the industry.

4) Demand studies can reveal seasonal variations and identify critical substitute products, information useful in determining the impact on consumers of a regulation imposed on a particular species or fishery, or the impact of a seasonal closure of a fishery.

While few data currently exist on the retail demand for seafood (Table 2-4), aggregate measures yield some information on gross trends. Per-capita consumption of all seafood rose steadily from 1983 to a peak in 1987 at 16.2 pounds per person (Fig. 2-22). Since then, there have been slight decreases in per-capita consumption of all seafood, but consumption of fresh and frozen seafood has been increasing since 1990, to 10.2 pounds per person in 1993. During the same time period, seafood prices, as measured by the consumer price index for fish, have climbed steadily, remaining above the average price of both poultry and meat since 1985 (Fig. 2-23). This suggests that the "average" consumer is purchasing increasingly more seafood despite higher prices, and it may indicate that the demand for seafood has increased over time.

American consumers are eating more and more meals away from home; expenditures on food eaten away from home have increased at about 2% per year since 1983 (USDA, 1993). According to a nationwide pilot study of seafood consumption performed in 1993 for NMFS, 44% of shellfish consumption and 29% of finfish consumption occurs in restaurants or establishments outside the home (NFI, 1994). Thus, if the trend toward eating out continues, seafood consumption will also likely increase.

The benefits of achieving economic sustainability of fisheries would extend to the retail sector. For example, a consistent supply of fish is cited as the biggest problem with "sourcing," or obtaining, seafood in a 1994 survey of more than 13,000 restaurants (Anonymous, 1994). While aquacultural products, typically produced with less seasonal

Seafood Safety

Seafood safety is an important issue facing the processing sector. Seafood processing is unique among food services because a wide range of species and products are handled, each with its own contamination and spoilage risks. Fish and shellfish contamination can arise from: bacteria and viruses from harvest waters, naturally occurring marine toxins; chemicals and elements in the water (i.e. mercury, lead, cadmium, PCB's, dioxins, and pesticides), and improper handling. In addition, establishment and enforcement of seafood safety standards are complicated by the wide variety of harvesting, handling, and processing methods.

Seafood processing quality is jointly overseen by the FDA, the Environmental Protection Agency (EPA), and NMFS. Regulation relies on mandatory, but periodic, inspections of seafood plants (by FDA) and on voluntary inspection and certification services (by NMFS). Infrequent visual inspection is inadequate for seafood because most contamination common to seafood cannot be detected this way. Therefore, the FDA and NMFS have proposed new methods for regulating the processing and wholesaling of seafood, collectively called HACCP, for Hazard Analysis of Critical Control Points. HACCP is a risk assessment system that identifies and regulates critical points of the production process prone to contamination or spoilage. Under this program, domestic processors, distributors (packers, repackers, wholesalers, and warehouses), importers (and therefore foreign processors shipping to the United States), and at-sea processors are required to develop and implement HACCP plans.

The impacts of HACCP on the industry are as yet unclear. However, the FDA has identified and quantified some of the expected benefits and costs of using HACCP principles. Some of the benefits are: 1) reduced seafood-related illnesses, 2) decreased consumer anxiety, 3) increased nutritional benefits from increased consumption, and 4) reduction in resources used to combat negative perceptions of seafood. The value of experiencing fewer illnesses as a result of a better seafood supply is estimated to be between $15 and $75 million; the value of fewer deaths as a result of positive health benefits associated with consuming more seafood (e.g., less cardiovascular disease) is estimated to be $3 to $14 billion.

The costs of compliance identified by the FDA include: 1) the cost of retrofitting equipment, 2) cost of corrective actions when problems are identified, 3) personnel training costs, 4) monitoring costs associated with ensuring desired safety levels are achieved, 5) the purchase of new equipment such as temperature indicators and recorders, 6) the initial cost of creating a HACCP plan; and (7) the ongoing cost of recordkeeping. The FDA projects that implementation of HACCP will cost the average plant $24,000 in the first year, and $15,000 each succeeding year. In the aggregate, FDA estimates a total cost of $103 million in the first year and $65 million per year in the following years. These costs do not include those of domestic repackers and warehouses or to foreign processors.

Table 2-4
Data needs and economic information for retail sector.

Item	Coverage of data/estimates: Complete	Partial	By special study
Quantity purchased, and unit price paid, for seafood products and substitute goods			✔
Socioeconomic characteristics of consumers			✔
Estimation of demand curves and consumer surplus, by seafood product or fishery			✔

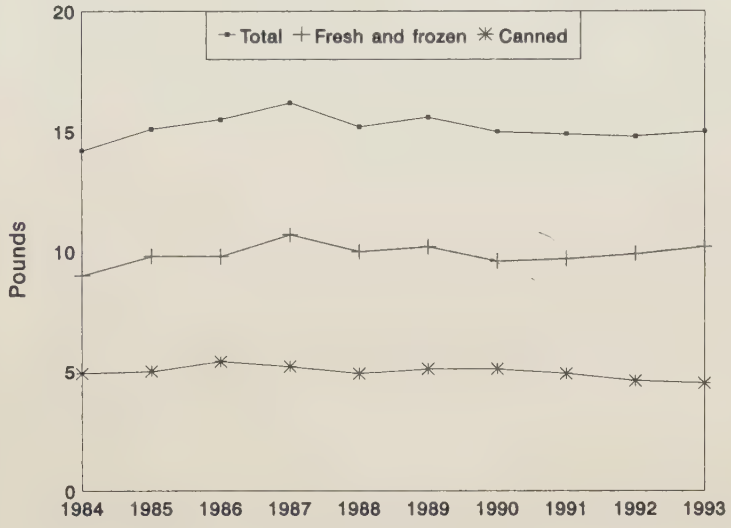


Figure 2-22
Per capita consumption of fish and shellfish.

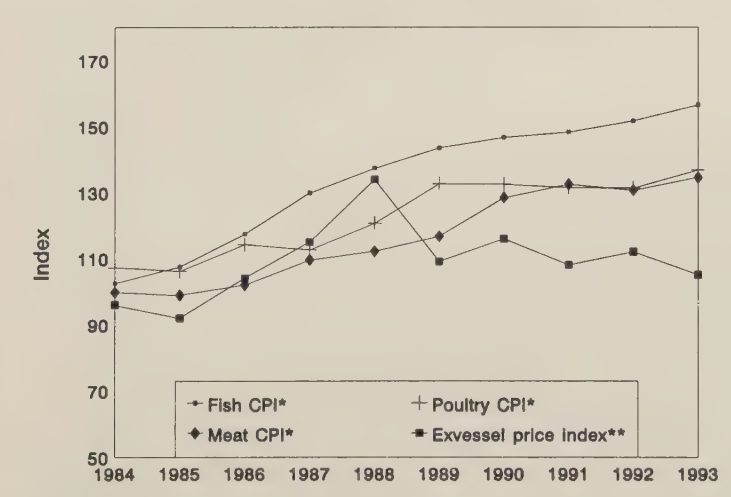


Figure 2-23
Consumer price index (CPI) for fish, poultry, and meats.

variation than open-access fisheries, may help ease this problem, fisheries regulations that result in an increased, steady and predictable supply of fresh product will assist the industry.

The U.S. Recreational Harvest Sector

Fishing is considered recreational when pleasure, amusement, relaxation, and/or home consumption or subsistence are the primary motivations (USDOC, 1994). Marine recreational fishing is defined by NMFS as "any fishing in marine waters that does not result in the sale or barter of all or part of the fish harvested".[7] In contrast, commercial fishermen generally harvest for pay. By definition, the recreational and commercial fishing sectors are considered mutually exclusive user groups. However, the recreational and commercial fishing sectors are interdependent and have much in common: 1) both groups depend upon a renewable fishery resource and thus benefit from a healthy ecosystem, 2) both groups often fish for the same species, and 3) services like ice, repairs, equipment sales, and dockside facilities support both the commercial and recreational fishing sectors (Radonski et al., 1986). Thus, policies aimed at regulating one group almost always impact the other and often affect other sectors of the marine fishing industry.

Assessing the net economic benefits from various allocation scenarios requires the estimation of anglers' consumer surplus (ACS), commercial fishermen's producer surplus, and, theoretically, the consumer surplus for commercial catch as well. Estimation of the consumer surplus of recreational fishermen is not simple, nor are the appropriate data typically available. However, advances in recreational demand modeling have been made in the past decade, and estimates of the value of several components of the recreational fishing experience are available for some fisheries. For example, recreational demand models have been used to estimate the value of access to recreational fishing, the value of individual trips, and the effect of water quality and catch rate changes on the value of recreational fishing. These models can be used to estimate the impact on anglers of a seasonal closure, the implementation of or a change in bag limits, or a minimum size limit on fish kept.

[7]Adopted by NMFS in February 1993.

Various techniques have been developed to estimate ACS, and fishery managers are recognizing that these estimates provide valuable information. Importantly, managers are acknowledging that expenditures on recreational fishing do not measure the value of the recreational fishing experience to anglers (Chapter 1 discusses the difference between economic impact analysis and cost-benefit analysis). As the issue of allocation of scarce fishery resources becomes increasingly important, better data and models will be needed to more accurately estimate the economic value of this important sector of the fishing industry (Table 2-5 describes the current status).

Table 2-5
Data needs and economic information for recreational sector.

Item	Coverage of data/estimates		
	Complete	Partial	By special study
Number of anglers, by fishery		✔	
Travel costs and expenditures on recreational fishing trips			✔
Socioeconomic characteristics of anglers			✔
Economic value (i.e., consumer surplus), by fishery			✔

Toward this end, a comprehensive study of anglers from New York to Florida was recently conducted by the University of Maryland, NMFS, and the Environmental Protection Agency (EPA) (McConnell and Strand, 1994). Among other things, this study estimates the annual value of access to saltwater fishing in each of the coastal states, the value of 2-month access, and the value of improved catch rates to anglers. A main objective of the study was to compare two methodologies used in recreational demand analysis (i.e. contingent valuation (CV) and random utility models (RUM)) and to evaluate the impact of the models on estimates of the value of recreational fishing.

Estimates of anglers' aggregate "willingness to sell" their rights to fishing for one year (data were collected in 1988-89) ranged from $77 million in Georgia to over $1 billion in Florida using the CV method; the estimated value of annual access using the RUM method ranged from $12.3 million in Delaware to $888 million in Florida. The study also estimates anglers' willingness to sell their fishing rights for a 2-month period, a scenario which might occur if a fishing area was closed temporarily due, for example, to an oil spill. As would be expected, average willingness to sell values were lowest between November and February, and were highest in July and August; people need greater compensation to give up fishing when the weather and catch rates are more favorable.

To demonstrate the usefulness of these models to policy makers, estimates of the willingness to pay to avoid a summer flounder moratorium by state and by 2-month period were calculated. Anglers were found to be willing to pay as much as $5.7 million to avoid the moratorium in New Jersey during July and August. In comparison, commercial harvest revenues for summer flounder in New Jersey in July and August of 1988 were $644,200 (recall that revenues do not measure producer surplus; revenues less variable costs would yield a measure of PS). While the two values are not directly comparable (e.g. commercial revenues are an overestimate of PS and do not include measures of the consumer surplus gained from summer flounder consumption), it is clear that in some fisheries, the value of the recreational sector may approach or exceed that of the commercial sector. Overall, the study demonstrates that 1) robust estimates of the recreational value of marine fishing can be obtained using a number of methods and 2) the value of recreational fishing is often quite high.

Conclusions

It is well established in fisheries economics literature that management systems that control access to fishery resources provide fishermen with the incentive to harvest in the least-cost manner. The key to effective fisheries management is to design and implement strategies that induce long-run optimal choices of capital, labor, and other inputs. Support for the changes necessary to achieve economically sustainable fisheries is embodied in NOAA's Strategic and Implementation Plans (USDOC, 1996), both of which include specific initiatives and activities critical for effective implementation and analysis of controlled access systems. Doing so will ensure that resource rents, dissipated under open-access, are captured, and benefits to the Nation are maximized.

Regardless of the management schemes chosen, fishery managers need to be able to determine the change in net economic benefits for each

user group to allocate scarce resources or to evaluate the effect of various regulations on stakeholders. It is critical to evaluate the producer surplus of fishermen, wholesalers and processors, and the consumer surplus of recreational anglers and seafood consumers. Understanding the decision-making behavior of commercial and recreational fishermen is a key to understanding how regulations will affect them and the fish stocks. This requires systematic collection of the relevant economic and sociological data, an improved understanding of the relevant markets for seafood products (wholesale, processing and retail) as well as the linkages between these markets, development of useful indicators of economic health that can be tracked over time and fisheries, and further development and application of appropriate models. Better data and models would give NOAA the ability to estimate the costs and benefits of regulations on a variety of user groups. All these important pieces of information are critical for making defensible management decisions.

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Chapter 3

The Alaska Regional Report

The Commercial Groundfish Harvesting Sector

Introduction

The domestic groundfish fishery in the U.S. EEZ off Alaska has become an important part of the total U.S. fishing industry. With a total catch of 2.1 million metric tons (t), a retained catch of 1.8 million t, and an ex-vessel value of $414 million in 1993, the domestic Alaska groundfish fishery accounted for 45% of the catch and 12% of the ex-vessel value of the catch off U.S. shores. The value of the resulting fisheries products after primary processing was $1 billion, and the value of the exports from this fishery exceeded $800 million in 1993, about 28% of the value of total U.S. exports of edible fishery products.

Two principal objectives of the Magnuson Fishery Conservation and Management Act of 1976 (MFCMA) were to maintain healthy fishery resources or to rebuild fishery resources to healthy levels and to replace the foreign fishing and processing operations with domestic operations. The domestic Alaska groundfish fishery has met both objectives with great success. Relatively conservative fishery management policies have resulted in the following: maintenance of high levels of productivity for most groundfish species, improvements in the condition of the fishery resources that had been overexploited by foreign fishing fleets, and relatively stable catch levels. At the same time, aggressive development policies resulted in the rapid displacement of the foreign fishery by the domestic fishery.

Unfortunately, the same fishery management process and regimes that were successful in meeting those two objectives not only allowed but encouraged fishermen and processors to make a variety of decisions that substantially increased the difference between the actual and potential values of the Alaska groundfish fishery to the Nation. Specifically, these decisions resulted in excessive investment in harvesting and processing capacity, excessive bycatch of nongroundfish species, excessive discard of groundfish, reduced product quality and value, and more hazardous working conditions. These management successes and failures in the domestic Alaska groundfish fishery are the topics of this chapter.

The Overall Management Regime

The domestic Alaska groundfish fishery is a regulated open-access fishery. The management regime is specified in two Fishery Management Plans (FMP's). The Gulf of Alaska (GOA) FMP and the Bering Sea/Aleutian Islands (BSAI) area FMP, developed by the North Pacific Fishery Management Council (NPFMC), became effective in 1978 and 1982, respectively.

Under each FMP, the total allowable catch (TAC), acceptable biological catch (ABC), and overfishing level are established annually for each species or species group and area. Some TAC's are subdivided by season, area, or user group. There are also bycatch limits for crab, Pacific halibut, and Pacific herring in the BSAI area and for Pacific halibut in the GOA. The bycatch limits or prohibited species catch (PSC) limits are apportioned annually among individual groundfish fisheries as defined by gear type, target species, area, and season.

An extensive program has been established to monitor the attainment of TAC's, ABC's, overfishing levels, and PSC limits. This program includes: 1) at-sea and on-shore observer coverage that varies with the size of the fishing vessel and the level of production of a processor, 2) weekly reports by all groundfish processors, 3) daily reports by processors and observers when necessary, and 4) fish tickets for all fishing vessels that land unprocessed groundfish in Alaska.

Generally, before the TAC for a particular groundfish species is taken, the fishery is closed for the remainder of the year or season. At that point, the species can be taken only as bycatch in other groundfish fisheries. (This region's spotlight

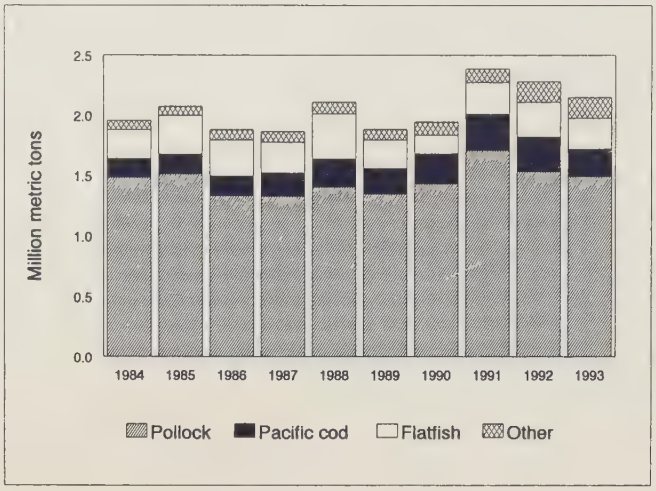


Figure 3-1
Groundfish catch in the commercial fisheries off Alaska by species, 1984-93.

article discusses the economics of bycatch). Once the TAC is taken, the species cannot be retained in any groundfish fishery. Finally, before the ABC and overfishing level are reached for a species, time/area closures or complete closures are imposed on any fishery that is expected to take a significant amount of that species as bycatch. The attainment of a PSC limit within a fishery also closes that fishery for the reminder of the year or season for a specific area or imposes a specific time/area closure.

In both the BSAI area and the GOA, PSC limits for Pacific halibut, have closed some domestic fisheries well before their groundfish quotas have been reached. In some instances, these closures resulted in a redistribution of catch among groundfish fisheries. However, in other cases, the closures have prevented some TAC's from being used fully.

The combination of relatively conservative TAC's, relatively effective catch and bycatch monitoring systems, and closures to enforce the TAC's, ABC's, overfishing levels, and PSC limits has contributed to meeting the goal of maintaining healthy groundfish resources and preventing overfishing.

Management Successes

During the 10-year period of 1984-93, the groundfish resources off Alaska have been generally healthy, total catch has been relatively stable at a high level, and the domestic fishery developed rapidly and completely displaced the foreign fisheries in the U.S. EEZ off Alaska. In terms of these three results, the groundfish fishery off Alaska has been managed successfully.

During 1984-93, total groundfish catch ranged between 1.9 and 2.4 million t, and in 8 of 10 years catch was within about 5% of 2.0 million t (Fig. 3-1). The catch estimates for 1991-93 are based on the method that is used currently to estimate groundfish catch. Had the current method actually been used in 1991 and 1992, several fisheries would have been closed earlier in the year and total catch would have been reduced. Total catch peaked in 1991, in part due to a change in the method used to estimate total catch.

Catch by species group has been less stable than total catch. Walleye or Alaska pollock has been the dominant species in the commercial groundfish catch (Fig. 3-1). For the 1984-93 period, annual pollock catches ranged from 1.3 to 1.7 million t and accounted for 66.3-75.5% of the total groundfish catch, and each year the direction of change in total catch was the same as that of pollock. Pollock, Pacific cod, and flatfishes comprised 92% of the total 1993 catch. Other important species are sablefish, rockfishes, and Atka mackerel. Although the majority of the catch of each of the dominant species is taken by vessels targeting on that species, large amounts of many species are taken as bycatch and discarded. Groundfish discards were estimated to be about 350,000 t in 1993. Estimates of total catch including discards are used to set and monitor TAC's.

The combination of relatively stable total catch and rapid development of the domestic fishery was possible only because there was a large foreign fishery that could be replaced. The Alaska groundfish fishery changed from a foreign-dominated fishery in 1984, to a predominantly joint-venture fishery, with domestic fishing vessels delivering catch directly to foreign at-sea processing vessels during 1986-88, and finally to a fully domestic fishery in 1991 (Fig. 3-2). Catch in the domestic fishery increased from 3.2% of the total in 1984 to 100% in 1991.

Trawl, hook and line, pot, and other gear are used in the domestic Alaska groundfish fishery. Annual landings and real ex-vessel values for virtually every gear group and species increased dramatically from 1984 to 1993 (Table 3-1). For the

10-year period as a whole, about 93% of the total landings were taken with trawl gear but only 76% of the real ex-vessel value was accounted for by trawlers because hook and line gear is used more for higher valued species. Most species are harvested predominately by one type of gear, which typically accounts for 90% or more of the landings. The one exception is Pacific cod, where in 1993, 57.8% of the catch was taken with trawl gear, 36.4% of the catch was caught with hook and line gear, and over 5% of the catch was captured with pots or traps.

The contribution of the groundfish fishery to the total ex-vessel value of all domestic fisheries off Alaska increased from 5.4% in 1984 to 34% in 1993 compared to 33% for Pacific salmon and 27% for shellfish. Groundfish replaced Pacific salmon as the highest valued commercial fishery off Alaska in 1991. The increase in the real ex-vessel value of the domestic fishery in 1992 (Fig. 3-3) was due to an increase in landings and in real ex-vessel prices, which included a 40% increase in the price of pollock. The price increases in 1992 appear to have been caused by an overreaction to increased uncertainty concerning the world supply of surimi. Surimi, the dominant pollock product, is an intermediate fish-paste product that is used to produce simulated shellfish and meat products. The subsequent price corrections and a weaker Japanese economy more than offset most of the price increases that had occurred in 1992.

The domestic fishery is a multispecies fishery in which the fishing vessels differ by size, ownership, gear, and mode of operation. The vessels that participate in this fishery range in length from less than 15 m to more than 150 m and include vessels that only catch fish, vessels that catch and process fish, and vessels that only process fish. Their owners range from independent fishermen who operate their own vessels to corporations that operate multi-vessel fleets.

The development of the domestic fishery would not have been possible without the substantial increases in harvesting capacity that occurred through increases both in the number of vessels participating in the fishery and in the average capacity of the vessels. The latter increases in capacity occurred due to improvements in fishing gear (including electronics), increases in vessel size, and an increase in the percentage of vessels using

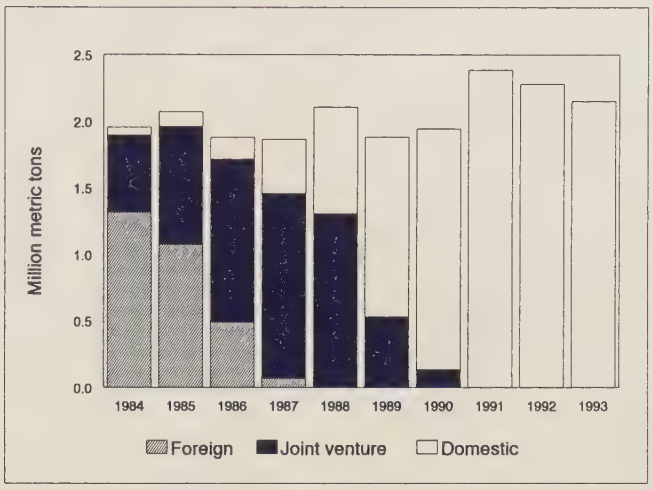
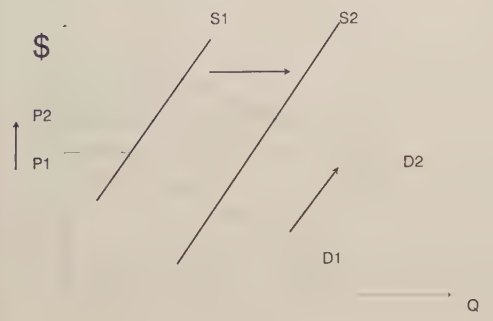


Figure 3-2
Groundfish catch in the commercial fisheries off Alaska by fishery, 1984-93.

Table 3-1
Landings and real ex-vessel values in the domestic Alaska groundfish fishery[1] by area, gear, and species, 1984-93, quantity (round weight) and value.

	Quantity (1,000 t round weight)			Value (million dollars)		
	Hook and line	Trawl	All	Hook and line	Trawl	All
1984	9.8	52.6	63.2	8.0	21.8	30.3
1985	13.4	98.3	114.7	18.6	23.8	46.3
1986	23.9	134.2	167.7	29.6	29.0	67.4
1987	42.5	362.4	407.3	51.4	84.3	137.8
1988	41.2	759.8	803.7	69.2	159.6	231.0
1989	50.2	1,301.8	1,352.6	61.3	250.5	312.1
1990	86.8	1,715.2	1,811.2	67.8	323.7	395.1
1991	99.6	1,575.0	1,691.4	84.8	313.2	406.1
1992	146.0	1,865.2	2,037.3	97.5	449.5	558.4
1993	105.6	1,721.0	1,838.6	77.5	253.0	335.1

[1]Source: NMFS office of the Pacific Marine Fisheries Commission.



Even though groundfish landings were increasing (S1–>S2), demand was increasing as well (D1–>D2), and the real ex-vessel price increased (P1–>P2). If demand had increased more than supply, the price would have increased.

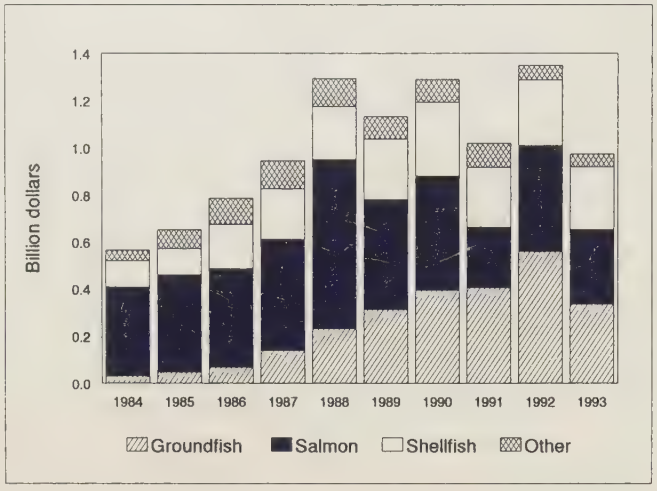


Figure 3-3
Domestic fishery real ex-vessel value of the catch off Alaska by species group, 1984-93.

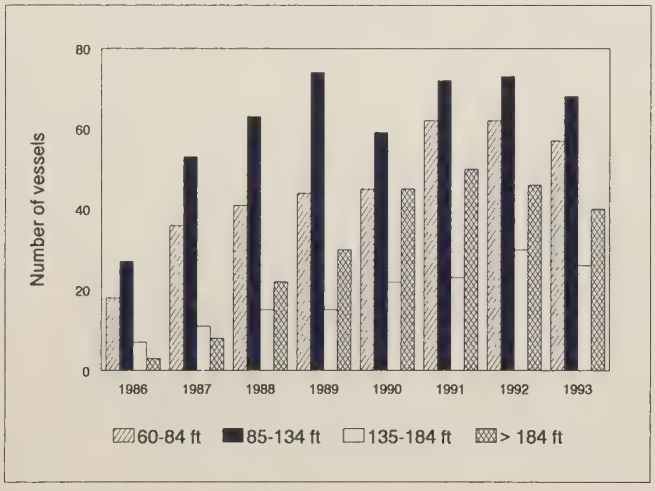


Figure 3-4
Number of trawl vessels in the domestic groundfish fishery by length class, 1986-93.

trawl gear. Estimates of the number of fishing vessels by length class are presented in Figures 3-4 and 3-5 for trawlers and for hook and line vessels, respectively. Both graphs reveal the peak in numbers of fishing vessels in all length classes in 1991-92 (except for 85–134 ft trawl vessels, which peaked in number in 1989, and >184 ft hook-and-line vessels which peaked in 1990).

Excess Harvest Demand and Associated Problems

Fishery management and development programs were successful in increasing the amount of fish allocated to domestic fishermen and processors. Increases in the domestic demand to harvest and process Alaska groundfish enabled the domestic fishery to displace the foreign and joint venture fisheries rapidly. This displacement provided increased employment and income opportunities for those involved in harvesting, processing, and marketing Alaska groundfish and for those in support sectors and communities. The estimates of the ex-vessel, processed product, and export values for the domestic fishery as presented in this chapter provide measures of the magnitudes of these opportunities. However, when the increased domestic demand to harvest fish could not be met by reductions in the quotas for the foreign and joint venture fisheries, there was excess domestic demand to harvest fish. That is, the domestic groundfish fishery had developed the ability and desire to use more fish of some species than was permitted by the catch quotas.

Excess demand and the associated problems occurred before the domestic groundfish fishery was able to use fully many of the groundfish TAC's. By the mid-1980's, there was excess demand for sablefish as a target species and for halibut and crab as bycatch species. There are several reasons why sablefish was the first groundfish species for which there was excess domestic demand. Sablefish was a relatively high-priced species, the larger vessels in the halibut fleet could enter the sablefish fishery at a relatively low cost, decreases in the length of the halibut fishing season provided an added incentive for those vessels to become more active in the sablefish fishery, sablefish had some of the smallest TAC's, and in addition to the hook and line gear similar to that used in the halibut fishery, pot gear could be used to harvest sablefish very effectively. The excess demand for the bycatch species occurred because the domestic fisheries for crab and Pacific halibut were developed fully which meant that crab and halibut bycatch in the groundfish fishery decreased catch in the domestic crab and halibut fisheries.

To address the problem of excess demand for sablefish, the NPFMC apportioned the sablefish TAC's by gear type first in the GOA and then in

the BSAI area. This response did not prevent subsequent increases in the excess demand for sablefish. To address the excess demand for crab and Pacific halibut, the NPFMC imposed halibut bycatch limits in the GOA and later established halibut and crab bycatch limits for the BSAI groundfish fishery. This response partitioned the quotas for Pacific halibut and crab between groundfish fishermen and crab and halibut fishermen, but it did not eliminate the excess demand for crab and halibut as bycatch in the groundfish fishery.

As domestic harvesting and processing capacity continued to increase, excess demand increased and became a more serious problem for some species and a new problem for other species. In the absence of an efficient mechanism either for eliminating the excess demand or for allocating the TAC's among competing fishermen, there have been a number of undesirable effects. These effects include: 1) increased incentives to expand harvesting and processing capacity because fishermen raced against each other to catch fish before the quotas were taken and the fisheries were closed for the year, 2) reduced season lengths, 3) increased harvesting and processing costs, 4) decreased product quality and value, 5) increased NPFMC efforts were focussed on allocation issues as opposed to setting TAC's, 6) increased cost and complexity of fishery management, and 7) decreased stability for the industry and dependent communities.

The utilization rate for at-sea processors provides one measure of excess harvesting and processing capacity. The at-sea processors include catcher-processors and motherships; the latter are vessels that only process fish caught by catcher vessels. The weekly utilization rates depicted in Figure 3-6 are defined as the number of at-sea processors operating during a week as a percentage of the number of at-sea processors that participated in the fishery that year. In 1988 and 1989, there was substantially less seasonality in the weekly utilization rates and both the minimum and maximum rates were higher than in the more recent years. Annual utilization rates, defined as the number of at-sea processor weeks during a year as a percentage of the maximum possible number of processor weeks, were calculated for 1988 through 1993. Consistent estimates were not possible prior to 1988 because there were less inclusive reporting requirements before 1988. The annual utilization rates are as follows: 1988, 50.4; 1989, 61.2; 1990, 57.2; 1991, 53.2; 1992, 48.7; 1993, 44.3.

It is not clear what utilization rate would constitute full utilization of the available at-sea processor fleet because some time is required to off-load processed products, rotate crews, resupply vessels, and conduct periodic maintenance. However,

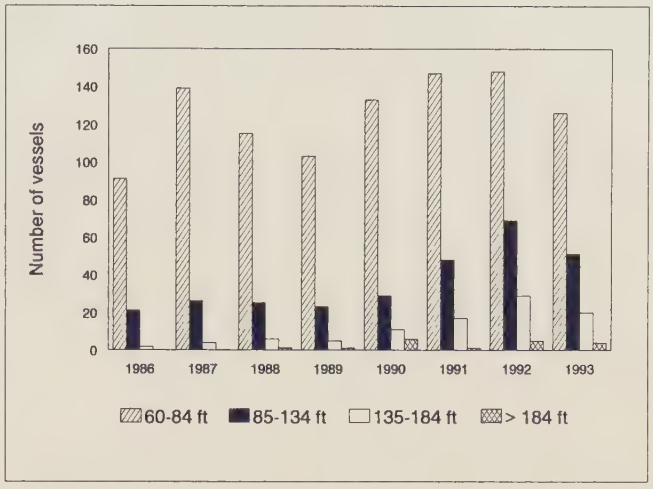


Figure 3-5
Number of hook and line vessels in the domestic Alaska groundfish fishery by length class, 1986-93.

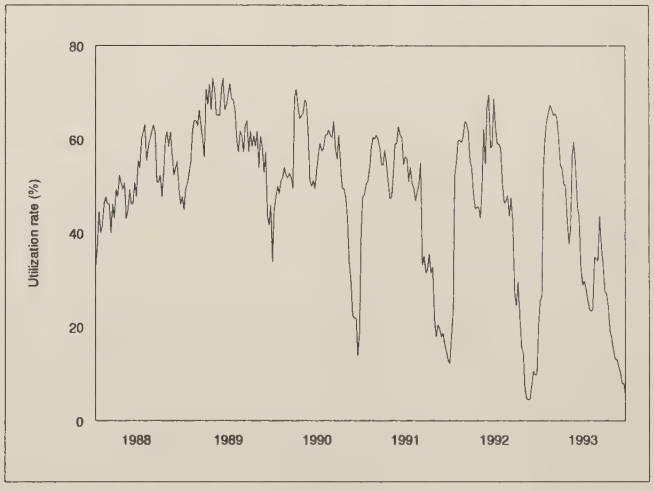


Figure 3-6
Weekly utilization rate for at-sea processors in the domestic Alaska groundfish fishery, 1988-93.

the annual decline in the utilization rate from 1989 through 1993 suggests that excess capacity was increasing during that period. A comparable statistic was not used for on-shore processors because they are more likely to be involved in other fisheries when they are not processing groundfish.

Another measure of excess capacity is the percent of weeks that catch was less than 25% of the maximum weekly catch each year. The values for this measure of excess capacity are as follows:

	Pollock	Other groundfish	All groundfish
1990	15.4	17.3	15.4
1991	53.8	23.1	50.0
1992	53.2	23.1	40.4
1993	65.4	28.8	61.5

A higher value indicates less stable weekly levels of catch during a year or increased excess capacity. The largest increase in excess capacity occurred in 1991 but a significant increase also occurred in 1993.

A measure both of the increase in excess capacity and of its effects is provided by the decreases in season lengths. In 1988, most of the BSAI area fisheries were open to the domestic fishery for 12 months. However, by 1993, few fisheries were open more than 6 months, and some of the largest fisheries were open for a much shorter period. For example, the open-access BSAI pollock fishery in 1993 lasted only 68 days for at-sea processors and only 100 days for trawlers delivering to on-shore processors. The Community Development Quota pollock fishery in the BSAI area lengthened the season for the few vessels that participated in that fishery. The Pacific cod fishery was open to trawlers and fixed-gear vessels 97 days and 130 days, respectively, in 1993. In the GOA, many of the area and season-specific apportionments of the TAC's were taken in less than 30 days in 1993.

There is general agreement that the race for fish has increased costs significantly, but estimates of the increases are not available. When fishermen race against each other to harvest fish before the fishery is closed by a quota for a target or bycatch species, harvesting and processing costs increase for the following reasons: increases in variable costs for fishermen and processors, increases in bycatch and discards, and decreased safety.

The race for fish also tends to decrease product value due to: 1) decreases in catch quotas, 2) decreases in the utilization of catch, 3) decreases in product quality due to handling, 4) decreases in the ability to take advantage of seasonal or random changes in consumption patterns and prices, 5) decreases in the ability to take advantage of seasonal differences in product quality, and 6) decreases in the ability to produce consistent quantity and quality throughout the year for products that do not have a highly seasonal demand. Catch utilization and product quality are reduced because less time is available to use the catch fully, to use fishing methods that increase the percentage of usable catch, or to maintain product quality. There is general agreement that the race for fish has decreased product quality and value, but estimates of the reductions are not available.

Typically, the NPFMC has five 5-day meetings each year. Setting TAC's has been a principal topic for only two meetings each year. It is estimated that the NPFMC spent only six of its 25 meeting days per year, or about 24% of its time, setting TAC's. The remainder of the time generally was spent on allocation issues. The NPFMC has submitted more than 60 amendments for the BSAI area and GOA FMP's combined. Many of the amendments address allocation issues. These amendments include: bycatch management measures including the PSC limits discussed above, direct apportionments of TAC's among gear groups or between vessels fishing for on-shore and at-sea processors, controls on the utilization of groundfish catch, the apportionment of part of some TAC's to groups of Native coastal communities in Western Alaska (Community Development Quotas (CDQ's)), and ITQ's for the fixed-gear sablefish and halibut fisheries.

The annual budgets and number of employees in terms of full-time equivalents (FTE's) for the Fishery Management Division of the NMFS Alaska Regional Office provide measures of the increases in the complexity and cost of managing the Alaska groundfish fishery. The Management Division is principally but not exclusively involved with groundfish management, and there are management costs beyond those of that division, such as: the Alaska Fisheries Science Center's observer program and biological and economic analysis programs, Enforcement, General Counsel, and the NPFMC. Therefore, the Management Division budget and the number of FTE's

provide useful but not complete measures of management costs. The following are the Fishery Management Division budgets in real (1987) dollars and FTE's by fiscal year.

Year	Budget	FTE
1990	$1,028,700	9.8
1991	$1,318,800	13.3
1992	$1,541,200	18.8
1993	$1,916,600	22.3
1994	$1,613,300	25.0

As the excess demand to harvest and process fish increases, the potential is increased that the planned participation in the groundfish fishery by a fisherman, fishing company, processor, or community will be preempted by participation by others. The inability to plan with any certainty the level and timing of participation in the groundfish fishery imposes costs on all participants. Estimates of these costs are not available.

Conclusions

The fishery management and development regimes for the groundfish fisheries off Alaska have been successful in that the groundfish resources are generally healthy, total catch has been relatively stable, and the domestic fishery has displaced the foreign and joint venture fisheries. These two regimes have been substantially less successful in terms of attaining the potential value of the domestic Alaska groundfish fishery to the Nation. This mixture of successes and failures demonstrates clearly that healthy fishery resources and high and stable levels of catch are not sufficient to ensure an economically healthy and productive fishery.

The failures have been due in part both to inadequate responses to the problems that are characteristic of a regulated open-access fishery and to a fishery development regime which exacerbated these problems. The development regime did that by continuing to provide a variety of incentives to invest in harvesting and processing capacity even after there was evidence of excess capacity. The management regime encourages over-investment in harvesting and processing capacity because the regime relies on an ineffective mechanism (the race for fish) to allocate fishery resources. In addition to encouraging over-investment which increases costs directly, the allocation mechanism provides fishermen with incentives to make decisions that are not in the best interest of either the fishermen as a group or the Nation, indirectly increasing costs and decreasing benefits. As excess capacity increases, the following also increase: conflicts among fishermen, conflicts between fishermen and other interest groups, the magnitude of the adverse effects of the collectively incorrect decisions made by individual fishermen, and the complexity, intrusiveness, and cost of fishery management.

There are a number of related reasons why there has been inadequate response to the problems associated with regulated open-access fishery management. First, the severity of the problems has not been recognized fully or in a timely manner by those who influence or establish fishery management measures. Second, there has been a tendency to use a piecemeal approach to implementing traditional management measures. This approach addresses individual symptoms of the problem and has prevented more complete consideration of management measures that address the source of the problem. Third, the expected change in the distribution of the net economic benefits from the fishery was often considered to be more important than the expected change in the magnitude of net economic benefits to the Nation. Finally, uncertainty concerning the biological, ecological, economic, and social effects of alternative management actions, including no action, has decreased the scientific basis for any decision.

The lack of a full and timely recognition of the severity of the problems is explained in part by the diversity of the problems and a tendency to focus attention on the most recent severe and obvious problem. The problems of the moment have included: the bycatch of crab, Pacific halibut, Pacific herring, and Pacific salmon; the allocation of groundfish TAC's among competing user groups; and the utilization of groundfish catch. Examples of competing user groups are: groundfish fishermen and other fishermen; the trawl, longline, and pot fleets; catcher vessels and catcher processor vessels; small and large vessels; mobile and less mobile vessels; owner-operated vessels and vessels owned by corporations; at-sea and on-shore processors; small and large processors or coastal communities; Alaska and non-Alaska participants in the fisheries; traditional participants and new or expectant participants; and fishermen, processors,

and the rest of society. The distribution of catch between such user groups can be measured, and it is usually quite obvious to a group when its share of the catch has either decreased or not increased enough. Unfortunately, it is much more difficult to measure the distribution of catch between fishermen who generate substantial net economic benefits from their catch and those who do not. Therefore, the loss to society of not having the former fishermen harvest a larger share of the TAC's often is ignored even though this is potentially a major source of foregone net economic benefits from the domestic Alaska groundfish fishery. That is, the differences in performance among individual fishermen or fishing operations and the importance of allocating fishery resources to the fishing operations that can use them most productively, hence maximizing net economic benefits, have not been adequately recognized.

The tendency to use traditional management measures in a piecemeal manner to address the symptoms of the problem exists for several reasons. First, fishery managers and fishermen are more familiar with traditional command-and-control management measures than with market-oriented measures. Second, the separate symptoms of the basic underlying problem often have been recognized and focused on independently; therefore, the search for a solution has been limited to the solutions that appear to address the most immediate symptom of a more pervasive problem. Third, with the Regional Fishery Management Council process, it is difficult to make large or once-and-for-all decisions that are required to establish a market mechanism to allocate the use of fishery resources. This difficulty exists in part because the MFCMA prevents the government from either selling the use rights associated with market-oriented measures or collecting fees from those who are given such use rights. Finally, concerns about the effectiveness and cost of enforcing market-oriented management measures have put into question the expected net economic benefits of such measures.

The magnitude and distribution of net economic benefits of a fishery determine its value to the Nation. However, there is no scientific or objective basis on which to determine, for example, whether a management measure that decreases net economic benefits but has a beneficial distribution effect would increase the value of the fishery to the Nation. In fact, there is neither a scientific nor objective basis for determining whether a specific change in the distribution of benefits by itself is beneficial. Unfortunately, the ability to consider alternative measures to meet the distribution objectives of the dominant interest groups, but at a lower cost to other groups or the Nation, was decreased when interest groups lost sight of their distribution objectives and became wedded to a particular solution.

Uncertainty concerning the biological, ecological, economic, and social effects of alternative management actions, including no action, has decreased the scientific basis for any decision. Due to this uncertainty, arguments of convenience can be used to support or oppose almost any management measure regardless of the actual objectives of the proponents or opponents of the measure. An additional effect of the uncertainty has been an increased reluctance to use nontraditional management measures such as market-oriented instruments.

A careful evaluation of the tradeoffs between traditional and market-oriented management measures is required to identify the appropriate mix of management measures for a particular fishery. In making such an evaluation, it should be recognized that many management problems have a common source and, therefore, reducing one problem could simultaneously reduce several other management problems. When problems are looked at individually, the synergy among solutions and benefits is ignored, and the evaluation of the tradeoffs tends to be biased in favor of traditional management measures.

An inability to respond more effectively to a range of fishery management problems is expected to continue to increase the costs and decrease the benefits of the fishery and, therefore, reduce the value of the fishery to the Nation. Economic analyses of the management issues addressed by the NPFMC have clarified and broadened the objectives for fishery management, improved the estimates of the magnitudes and distributions of net economic benefits for alternative management actions, and resulted in an increased understanding of the nature and sources of the management problems. However, such analyses are just one of the critical requirements for improving management of the domestic Alaska groundfish fishery.

The Groundfish Processing Sector

The development of the domestic fishery required substantial increases in domestic processing capacity. Much of the increase in at-sea and on-shore processing capacity was financed by foreign investment. It was the increase in domestic processing capacity that resulted in the displacement of the joint venture fishery. A consistent time series of processing data is not available for 1984-93. However, landings data for at-sea and on-shore processors provide an indication of the rates of growth of these two components of the processing sector. Landings for both modes of operation increased significantly between 1986 and 1993. During that period, landings for on-shore processing ranged from 24.3% to 41.2% of the total landings and increased from 61,500 t to 599,600 t, while landings for at-sea processing increased from 106,200 t to 1,239,000 t (Fig. 3-7).

Consistent groundfish processing data have been available since 1990. By 1990, the groundfish fishery off Alaska was almost exclusively a domestic fishery; therefore, the expansion of the domestic fishery was basically complete, and total processing output was relatively constant, varying only between about 545,000 t and 568,000 t for 1990 through 1993. There was significantly more variability in the value of the groundfish processed products. The real value of these products increased from about $945 million in 1990 to almost $1.2 billion in 1991 and then decreased to

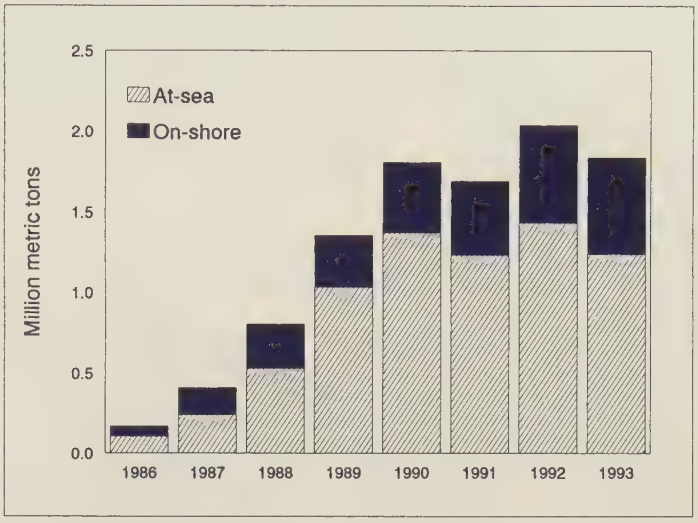
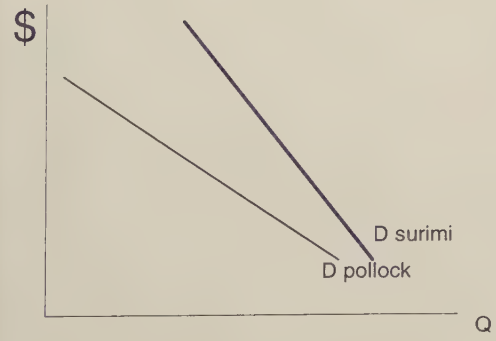


Figure 3-7
Landings in the domestic Alaska groundfish fishery for on-shore and at-sea processing, 1986-93.

$827 million in 1993. The 36.4% increase in product value between 1990 and 1991 and the subsequent decreases were the result principally of market adjustments for pollock surimi. Uncertainty concerning the total world supply of surimi in late 1991 and early 1992 appears to have caused pollock surimi price increases that could not be sustained beyond 1992.

All the estimates of processed product values presented above are for primary processing. Subsequent domestic processing, which occurs principally outside of Alaska, results in substantial increases in product value. An important example is using pollock surimi to produce simulated crab, scallop, and shrimp meat. This secondary processing of surimi has contributed significantly to processing employment, income, and output. The importance of surimi analog products is discussed more fully in the West Coast Regional Report.

Because many of the domestic catcher vessels that delivered fish to foreign processing vessels in the joint venture fishery were not well suited for making deliveries to on-shore processors, they were displaced by factory trawlers, at least temporarily. The displacement of catcher vessels by larger factory trawlers and the competition between the at-sea processor fleet and on-shore processors resulted in substantial animosity toward that fleet and a regulatory action that allocated the BSAI pollock TAC's and the GOA pollock and



The demand for pollock is a "derived demand," derived from the wholesale demand for surimi. Because there are economics of scale in surimi production, the marketing margin would decrease with the quantity processed.

Pacific cod TAC's between at-sea and on-shore processors. That regulatory action helps to explain the reductions in the total catch and share of total catch taken for at-sea processing in 1993.

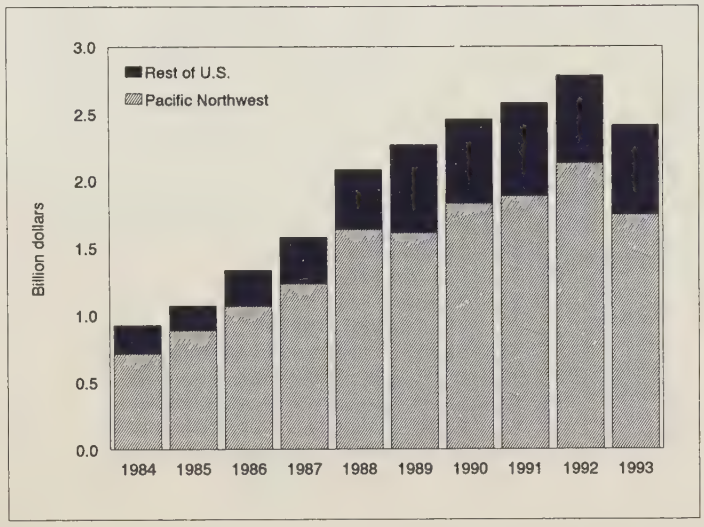


Figure 3-8
Pacific Northwest and total real value of U.S. exports of edible fishery products, 1984-93.

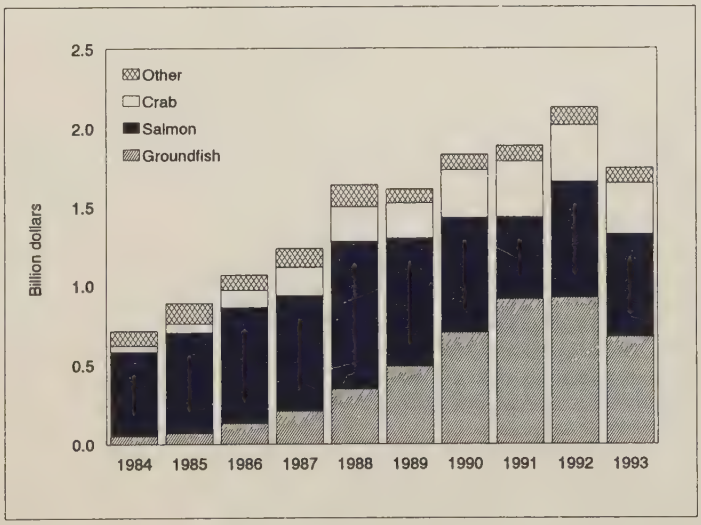


Figure 3-9
Pacific Northwest real value of exports of edible fishery products by major product groups, 1984-93.

The Pacific Northwest Trade Sector

In the absence of consistent production data, export data are used to describe the growth of the processing sector for this fishery because a high percentage of the processed products from this fishery is exported. Historically, a significant portion of the groundfish and other species harvested off Alaska has been shipped to Washington or Oregon prior to being exported, and these fish accounted for a significant portion of the fishery exports from Washington and Oregon. Therefore, the Pacific Northwest export data presented in this chapter are for the Oregon, Washington, and Alaska customs districts (consequently, the West Coast Regional Report does not contain a separate section on the trade sector).

The real value of Pacific Northwest exports of edible fishery products increased annually from $712 million in 1984 to almost $2.1 billion in 1992 and then decreased to $1.7 billion in 1993 (Fig. 3-8). The sharp decrease in exports from 1992 to 1993 primarily reflected the weaker economy in Japan and lower prices for surimi, pollock roe, sablefish, and salmon. On average, between 1984 and 1993, Pacific Northwest exports accounted for over 76% of the total U.S. exports of edible fishery products.

Much of the growth in Pacific Northwest exports of edible fishery products since 1984 is due to the development of the domestic Alaska groundfish fishery. For 1984-93, the exports of groundfish, including Pacific halibut, increased from $52 to $674 million and the share of total Pacific Northwest edible fishery exports accounted for by Alaska groundfish increased from 7.2% to 38.7% (Fig. 3-9). Pacific salmon, which had been the dominant fisheries export for many years, accounted for 74% of the Pacific Northwest fisheries exports in 1984 and only 27.6% in 1991, when groundfish accounted for 48.4% of the exports. Groundfish accounted for 60% of the $1.0 billion dollar real increase in exports between 1984 and 1993; salmon accounted for only 11.5% of the increase.

Japan had been a major participant in the foreign groundfish fishery off Alaska, and the Japanese fishery off Alaska was an important source for its domestic markets. As Japan's allocations of groundfish in the U.S. EEZ off Alaska were reduced, catch by Japanese vessels fishing off

Alaska was replaced to a great extent by imports from the Pacific Northwest. Japan is now the dominant importer of Pacific Northwest groundfish, accounting for 77% of the groundfish exports between 1984 and 1993. The real value of groundfish exports to Japan increased annually from $55 million in 1984 to $739 million in 1992, before decreasing to $536 million in 1993 (Fig. 3-10). The decrease in exports from 1992 to 1993 again reflects the weaker economy in Japan and the decreases in prices for surimi, pollock roe, and sablefish. The magnitude of the Japanese domestic market is underreported by these statistics because a significant part of the Pacific Northwest groundfish exported to Korea is reexported to Japan.

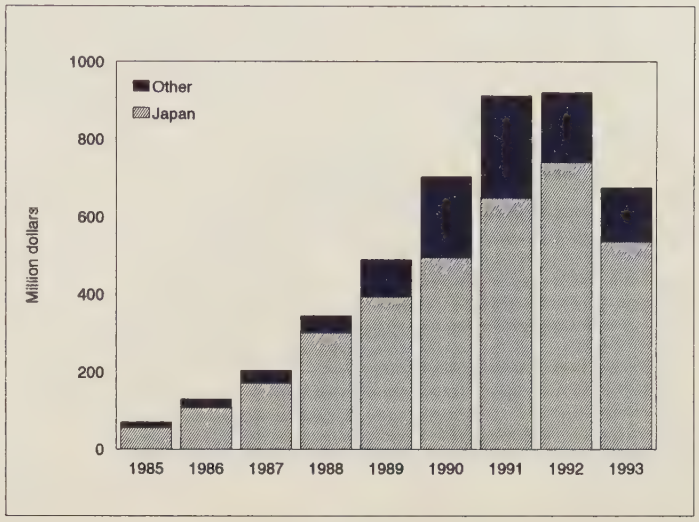


Figure 3-10
Pacific Northwest real value of groundfish exports by major country of destination, 1985-93.

The Recreational Harvest Sector

Summary Statistics

Alaska's 6,640 miles of coastline offer many and varied sportfishing opportunities. This section focuses on marine finfishing, and it therefore provides only a partial picture of the entire recreational fishery, since about 70% of total angler trips and 64% of total recreational finfish harvest (Mills, 1984-94) are made from fresh rather than marine waters.

During 1990-93, the number of marine anglers and the number of trips they made were relatively stable. Nonresidents comprised 45-48% of the total angling population and took 29-39% of all trips. They averaged 1.5-1.9 trips per year, compared with 2.8-3.3 trips per year for resident anglers. About 265,278 anglers made 635,783 trips in 1993 (Fig. 3-11, 3-12). Although out-of-state anglers averaged fewer trips, the sheer distance traveled to reach those fishing sites, and the associated costs of getting there, are indications of the importance of recreational fishing in Alaska.

Although finfishing activity was relatively stable during 1990-93, it increased significantly over the longer term period 1984-93 (Fig. 3-13). Factors contributing to this trend include increased demand for fishing, particularly by nonresident anglers, and the burgeoning charter boat industry. The number of shore trips increased from 42,500 in 1984 to 107,500 in 1993. Boat trips increased from 211,532 in 1984 to 491,497 in 1993. Between 1984 and 1993, total trips were split about 20-80% between shore and boat modes, respectively.

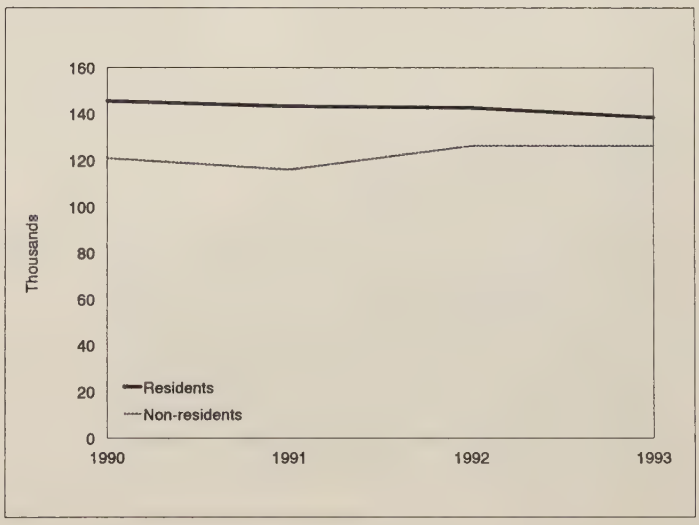


Figure 3-11
Estimated number of marine anglers in Alaska.

Harvest has not increased commensurately with the number of trips. For instance, from 1984 to 1993, boat trips increased by 132%, while boat-based harvest increased by only 81%. Over this same period, shore trips increased by 153%, while shore-based harvest actually declined by 38% (Fig. 3-13, 3-14). These changes reflect significant decreases in harvest per trip over time. The statistics pertain to fish harvested (i.e., caught and

Table 3-2
Estimated average distribution of 1983-93 marine finfish harvest in Alaska, by species group and fishing mode[1].

Species group	Shore %	Boat %	All modes %
Coho	13.3	17.1	16.0
Pink	25.5	10.6	13.5
Other salmon[2]	8.4	10.1	9.5
Total salmon	47.2	37.8	39.0
Halibut	3.2	34.0	27.2
Rockfish	3.4	15.3	12.5
Smelt	24.9	2.2	8.2
Trout	10.9	2.5	4.4
Other finfish	10.3	8.1	8.7

[1]Source: Mills, 1984-94.
[2]Chinook, sockeye, and chum salmon.

Table 3-3
Estimated consumer surplus and annual expenditures associated with marine fishing in Alaska in thousands of dollars (base year=1987)[1].

	Consumer surplus			Fishing expenditures			
	Resident	Nonres.	Total	Resident	Nonres.	Total	Total WTP
1990	$93,235	$40,430	$133,670	$61,557	$80,926	$142,504	$276,174
1991	$89,846	$31,958	$121,804	$59,338	$63,961	$123,300	$245,105
1992	$103,333	$32,676	$136,010	$68,246	$65,398	$133,645	$269,665
1993	$84,841	$42,345	$127,186	$56,033	$84,749	$140,782	$267,968
Avg.	$92,814	$36,853	$129,668	$61,299	$73,759	$135,058	$264,726

[1]Source: Jones and Stokes Associates, Inc., 1987, 1991; Mills, 1985-94.

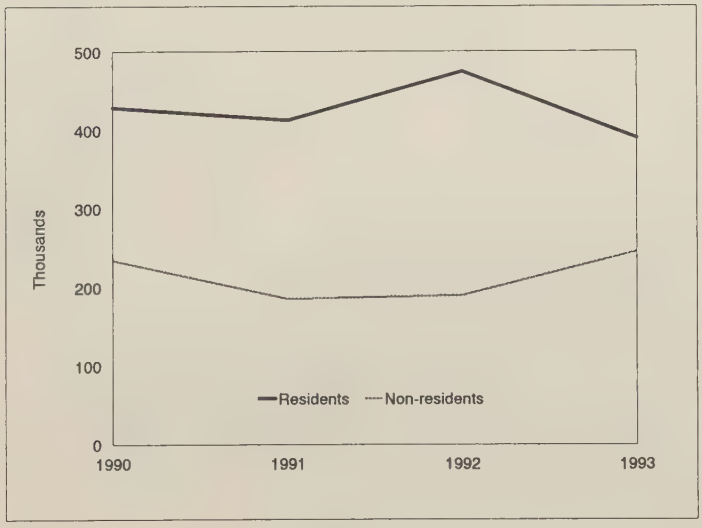


Figure 3-12
Estimated number of recreational fishing trips taken in Alaska.

kept). A significant proportion of total finfish catch—45% during 1990-93 (Mills, 1991-94)—is not kept.

For shore-based trips, the average number of fish harvested per trip declined from about 4.1 fish in 1984 to 1.6 fish during 1985-89 and to 1.1 fish during 1990-93. For boat-based trips, average harvest per trip was about 2.2 fish in 1984 and 1.4 fish during 1985-93 (Fig. 3-13, 3-14). Factors contributing to the declining trend in harvest per trip include increased popularity of catch-and-release, particularly by nonresident anglers, and decreased availability of some species in some geographic areas.

The species composition of harvest varies significantly by fishing mode (Table 3-2). During 1983-93, shore-based harvest consisted largely of pink salmon, smelt, coho salmon, and trout. The boat-based harvest consisted largely of halibut, coho salmon, rockfish, and pink salmon.

Angler consumer surplus for recreational fisheries in Alaska have been estimated to be $129.7 million (Table 3-3). Recreational fishing expenditures are about $135.1 million. Additional benefits are also generated to the state economy in terms of employment.

Regulation and Management Issues

The State of Alaska imposes licensing requirements on resident and nonresident anglers 16 years of age and older, and also requires a tag for chinook salmon fishing. Gear restrictions are placed on sport fishing in general, as well as on specific activities like ice fishing, freshwater fishing, and fly fishing. Area closures are utilized, as are seasonal closures for selected species. Bag, possession, and/or size limits are imposed on salmon, trout, halibut, grayling, rockfish and various species of shellfish (ADFG, 1993).

The major management issues relevant to the sport fishery pertain to allocation of fishery resources. At the international level, an ongoing issue in Alaska has been the share of the chinook salmon quota that the state receives under the U.S.-Canada treaty. A number of local salmon allocation issues have also arisen involving sport vs. commercial interests and charter vs. private boat interests. Similar allocation issues have arisen in the context of the halibut fishery. The State Board of Fisheries, which is responsible for resolving such issues, sometimes finds its authority chal-

lenged when the State Legislature is asked to intercede on behalf of dissatisfied interest groups.

The Native Land Claims Settlement Act is a Federal law requiring that a subsistence priority for all fish be given to rural residents of Alaska when the harvestable surplus is insufficient to meet the needs of all users. This prioritization is not consistent with the Alaska Constitution, which prohibits discrimination on the basis of residence. The Federal government is now threatening to assume management of subsistence fisheries on Federal lands, the outcome of which would be disjointed management on the basis of political jurisdiction.

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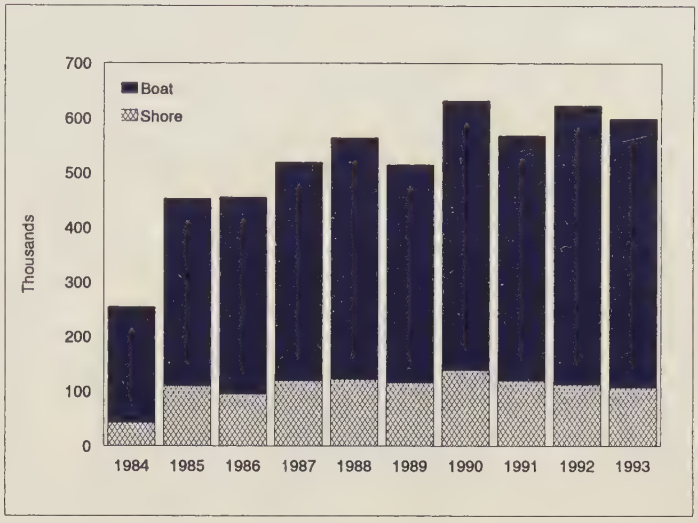


Figure 3-13
Estimated number of recreational fishing trips taken in Alaska, by mode.

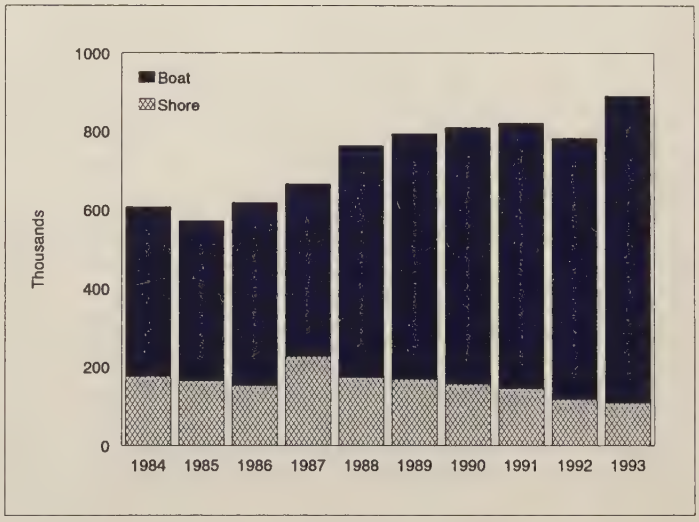


Figure 3-14
Estimated number of marine finfish harvested in Alaska, by mode.

Alaska Spotlight Article

The Economics of Bycatch and Bycatch Management in the U.S. EEZ Groundfish Fisheries off Alaska

Introduction

In response to concerns about the levels of bycatch in the Bering Sea/Aleutian Islands (BSAI) area and Gulf of Alaska (GOA) groundfish fisheries, the North Pacific Fishery Management Council (NPFMC) has recommended and the Secretary of Commerce has approved and implemented a variety of management actions that are intended to help control the bycatch of Pacific halibut, crab, herring, and salmon in the groundfish fisheries. Recently, the bycatch of groundfish in the groundfish fisheries and the bycatch of crab in the BSAI area crab fisheries have also received increased attention. Of the 34 amendments to the BSAI groundfish fishery management plan (FMP) that have been considered by the NPFMC since 1982, 13 addressed primarily bycatch issues and 9 additional amendments addressed some aspect of bycatch management.

This spotlight article presents a conceptual framework that can be used to understand the nature and source of the bycatch problem and to evaluate alternative management measures to control bycatch. It also identifies bycatch management measures that have been used to control bycatch in groundfish fisheries within the U.S. Exclusive Economic Zone (EEZ) off Alaska, with an emphasis on the BSAI area fisheries. These are open-access fisheries in which quotas are used to control total catch (i.e., retained and discarded catch) by groundfish species or species group.

The Nature and Sources of the Bycatch Problem

The nature and sources of the bycatch problem are explained by the answers to the following five questions: 1) What is bycatch? 2) Why does bycatch occur? 3) When is bycatch a problem? 4) What is the appropriate level of bycatch? (5) Why are there currently excessive levels of bycatch? Each question is answered in detail below.

What is Bycatch?

Bycatch, or more specifically bycatch mortality, is a consumptive use of living marine resources (LMR's) which includes most of the components of total fishing mortality. The components of total fishing mortality include: 1) the retained catch of the targeted species, 2) the retained catch of nontargeted species, 3) the discarded catch that does not survive, 4) mortality resulting from lost fishing gear (i.e., ghost fishing), and 5) mortality resulting from other direct interactions between fish and fishermen, fishing vessels, or fishing gear. Often, it is difficult to obtain good estimates for the amount of retained catch, and it is even more difficult to generate good estimates for the other components of fishing mortality. In addition, it is often difficult to differentiate between targeted and nontargeted species.

Bycatch mortality clearly includes the discarded catch that does not survive and excludes the retained catch of the targeted species. Although there is no general agreement concerning whether bycatch mortality should include the other three components of fishing mortality listed above, they are included as bycatch in this report. Therefore, bycatch mortality is defined as the total fishing mortality excluding that accounted for directly by the retained catch of the targeted species. The components of fishing mortality included in this definition of bycatch are by-products of efforts to catch specific fish that will be retained. That is, the objective of fishermen is

to catch and retain specific groups of fish defined by species, size, quality, sex, or usability, but in doing so they also inflict fishing mortality on other groups of fish.

With a narrower definition of bycatch, bycatch could be reduced without decreasing the fishing mortality not accounted for by the retained catch of the targeted species. That is, one of the by-product components of fishing mortality might simply be replaced by another. The distinction is made between bycatch and bycatch mortality because not all of the former results in fishing mortality. This distinction is important in that it identifies reductions in the handling or discard mortality rates as a potential method of reducing discards as a source of fishing mortality. This distinction is made for the halibut bycatch limits that are used in the BSAI area and GOA groundfish fisheries. The limits, which are in terms of estimated bycatch mortality, have resulted in effective efforts to decrease both incidental catch rates and discard mortality rates. For purposes of this discussion, bycatch mortality will be referred to simply as bycatch.

Why Does Bycatch Occur?

Bycatch occurs because fishing methods are not perfectly selective and because fishermen often have a sufficient incentive to catch more fish than will be retained. Although some methods of fishing are more selective than others, there are few examples of methods that are perfectly selective for species, size, quality, or sex. An incentive exists to catch more fish than will be retained if the fisherman's cost of the additional catch is less than the expected benefit; the latter depends on the probability that the catch will be retained.

When is Bycatch a Problem?

When fish are taken as bycatch in a specific fishing operation and fishery, other uses of those fish are precluded. The alternative uses of fish include: 1) retained target catch by that fishing operation, 2) catch and bycatch in the same commercial fishery but by another fishing operation, 3) catch and bycatch in another commercial fishery, 4) catch and bycatch in subsistence and recreational fisheries, and 5) contributions to the stock and other components of the ecosystem.

The value to the Nation of a specific use of fish is determined by the net benefit of that use and by the distribution of the net benefit. The net benefit of a use is the difference between the value of the outputs from that use and the value of all the inputs associated with that use. The inputs used in a commercial fishery include fish taken as target catch and bycatch; other LMR's; the fishing vessels, gear, and bait used in harvesting; the plants or vessels, equipment, and materials used for processing; the fuel and labor used throughout the production process, and all the inputs used to manage the commercial fishery. The cost of each input should be measured in terms of its opportunity cost, which is its value in its highest valued alternative use.

Bycatch is a problem if it precludes higher-valued uses of fish and if the cost of reducing bycatch is significant. If the former condition is not met, there is not a better use of the fish taken as bycatch. If the latter condition is not met and if higher-valued uses exist, the solution to the problem is trivial: all bycatch would be eliminated at an insignificant cost. Bycatch can also be a problem if it significantly increases the difficulty of monitoring and controlling total fishing mortality.

What is the Appropriate Level of Bycatch?

Basically, it makes sense to reduce bycatch in a cost-effective manner to the level at which further reductions would increase costs more than benefits. Both costs and benefits should be defined broadly from the Nation's perspective to include those that accrue to direct and indirect participants in the fishery as well as to other members of society. Those who harvest or process fish, those who provide support services to the harvesting and processing sectors of the fishing industry, and consumers of the fishery products are examples of direct and indirect participants in the fishery and of other members of society, respectively. "Cost-effective" refers to the lowest cost method of achieving a given reduction in the level of bycatch.

The hypothetical marginal benefit and marginal cost curves in Figure 1 present graphically the concept of the optimum level of bycatch. The marginal benefit and cost curves, respectively, depict the benefit and cost of reducing bycatch by

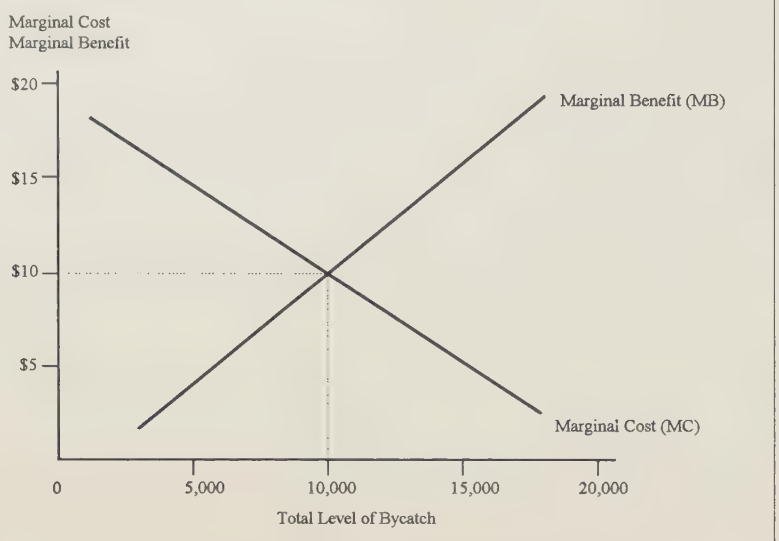


Figure 1
The marginal benefit and marginal cost of reducing bycatch and the optimum level of bycatch.

one unit for a given level of bycatch. For example, when the level of bycatch is 5,000 units, the marginal cost is about $15 and the marginal benefit is about $4. One unit would be one fish if bycatch is measured in the number of fish taken as bycatch, or one unit would be 1 metric ton if bycatch is measured in metric tons. For the groundfish fisheries, the salmon and crab bycatch is measured in numbers of salmon and crab, respectively, but halibut, herring, and groundfish bycatch is measured by weight, usually in metric tons or kilograms.

The following two definitions can be used to ensure that each change in benefits and costs is accounted for in either the marginal benefit or marginal cost curve but not in both. First, marginal benefit equals the sum of the increases in benefits and the decreases in costs of a reduction in bycatch. Second, marginal cost equals the sum of the increases in costs and decreases in benefits of a reduction in bycatch. Other definitions can be used to assure that all benefits and costs are accounted for once, but only once, without changing the conclusions presented below.

Given these two definitions, marginal benefit includes the decrease in the total opportunity cost of using fish as bycatch, the decrease in the cost of sorting the catch, and any other decrease in fishing costs. Marginal cost includes the increase in fishing costs and the decrease in benefits from any reduction in retained catch.

The marginal benefit is expected to increase, but not necessarily steadily, as bycatch increases. At very low levels of bycatch, most of the fishing mortality of the species taken as bycatch is accounted for by other uses and the value of some of the other uses probably are quite low; therefore, the opportunity cost of bycatch and the marginal benefit of reducing bycatch are low. However, at very high levels of bycatch, much of the fishing mortality is accounted for by bycatch and the lower valued uses would have been eliminated; therefore, the opportunity cost of bycatch and the marginal benefit of reducing bycatch are high.

The opposite trend is expected for marginal cost; that is, marginal cost is expected to decrease, but again not necessarily steadily, as bycatch increases. When there are high levels of bycatch and little has been done to control bycatch, there are probably some simple and low-cost actions that can be taken to reduce bycatch. Eventually however, increasingly difficult and often very costly methods would be necessary to eliminate the last few units of bycatch.

If the marginal benefit and cost curves include all the benefits and costs to the Nation, the optimum level of bycatch, in terms of total net economic benefits, is the level at which marginal cost and marginal benefit are equal. In the hypothetical example depicted in Figure 1, marginal cost and marginal benefit both equal $10 when bycatch equals 10,000 units. At lower levels of bycatch, the marginal cost of reducing bycatch is greater than $10 and the marginal benefit is less than $10; therefore, reducing bycatch below 10,000 units would decrease net benefit. However, at higher levels of bycatch, the marginal cost is less than $10 and the marginal benefit is greater than $10; therefore, net benefit would be increased by decreasing bycatch.

The implications of not using cost-effective methods of controlling bycatch are depicted in Figure 2. Curves MC1 and MC2 in Figure 2, respectively, are the marginal cost curves when cost-effective methods are and are not used. In this example, the optimum level of bycatch is 10,000 units when the cost-effective methods are used, but it is 15,000 units when they are not used. This discussion illustrates the critical role of technology in determining the optimal levels of bycatch reduction.

Why are There Currently Excessive Levels of Bycatch?

A common response to this question is that greed or lack of concern by the fishermen results in excessive bycatch. Perhaps a more productive response is that excessive bycatch is but one symptom of flawed fisheries management which substantially reduces the net economic benefits generated by the commercial fisheries.

More specifically, excessive bycatch is the result of the following set of circumstances: 1) the level of bycatch and the methods used to reduce bycatch are determined by individual fishermen in response to a variety of incentives and constraints that reflect the economic, social, regulatory, biological, and physical environments in which they operate, 2) an individual fisherman will tend to control bycatch up to the point where further changes would increase his cost more than his benefit, 3) a fisherman will define cost-effective methods of reducing bycatch in terms of the costs he pays, 4) the fisherman's benefit from reducing his bycatch is less than society's; and 5) in an open-access fishery for which there is a quota, the fisherman's cost of reducing his bycatch is greater than society's. These circumstances result in an individual fisherman making inadequate and noncost-effective efforts to control bycatch. Basically, due to the existence of external benefits and costs, individual fishermen receive the wrong signals or incentives and make the wrong decisions from society's perspective, as well as from the perspective of the fishermen as a group. There are external benefits (costs) when there are differences between the benefits (costs) to the fisherman and to society as a whole associated with an action taken by a fisherman.

This set of circumstances and the results are depicted by curves MBF, MBS, MCF, and MCS in Figure 3, which are, respectively, the marginal benefit curves for a fisherman and for society at large including the fisherman, and the corresponding marginal cost curves. In this case, the marginal cost and benefit are for a one-unit reduction in bycatch by a specific fisherman or fishing operation.

The MBS curve includes the reduction in the opportunity cost of using fish as bycatch and the decrease in sorting cost for the fisherman. However, because the fisherman does not pay the opportunity cost of the bycatch, the MBF curve includes principally the reduction in sorting cost.

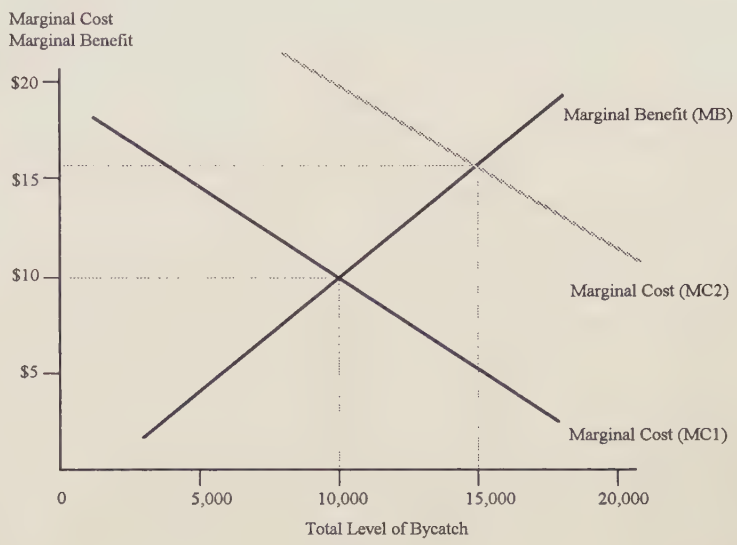


Figure 2
The marginal benefit (MB), marginal cost of reducing bycatch with cost-effective methods (MC1), marginal cost of reducing bycatch without cost-effective methods (MC2), and the optimum levels of bycatch with and without cost-effective methods of reducing bycatch.

That is, because the opportunity cost of bycatch is an external cost, the MBS curve is above the MBF curve.

In an open-access fishery with a catch quota, the MCF curve is above the MCS curve due to the external cost caused by the race for fish. This externality exists because, although the cost to the fisherman includes a reduction in his catch if his attempts to reduce bycatch decrease his rate of harvest relative to that of the rest of the fleet, the reduction in the fisherman's catch is not a cost to society. For the fleet as a whole, there is a redistribution of catch among fishermen, not a reduction in catch. This externality also results in a fisherman selecting methods to control bycatch that are not cost-effective from society's perspective. The externality does this by creating a bias in favor of methods that do not decrease a fisherman's catch. As a result of noncost-effective methods being used by fishermen to reduce bycatch, the MCS curve is higher than it would otherwise be.

From the fisherman's perspective, it makes sense to control bycatch to the point at which the MBF and MCF curves intersect. For the hypothetical example depicted in Figure 3, the MBF and MCF curves intersect when bycatch for this one fishing operation is about 285 units. However, the

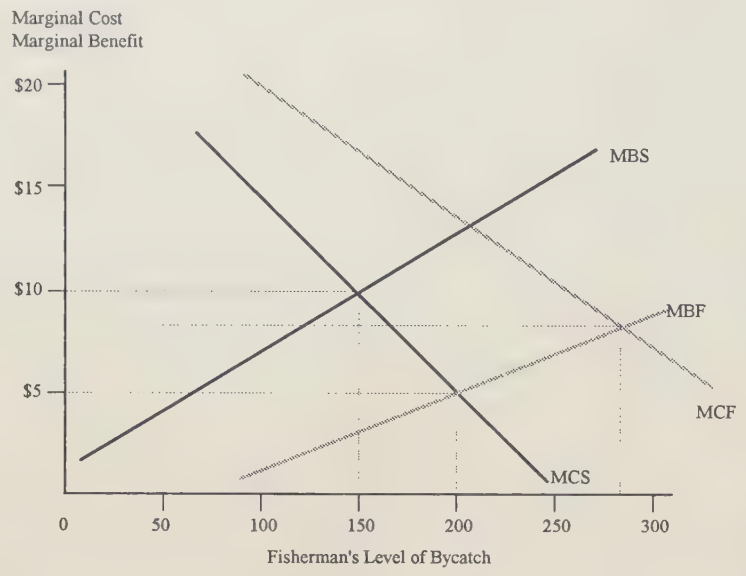


Figure 3
The marginal benefit to the fisherman (MBF), marginal benefit to society including the fisherman (MBS), marginal cost to the fisherman (MCF), marginal cost to society (MCS) of reducing bycatch, and the optimum levels of bycatch, respectively, for the fisherman and for society.

MBS and MCS curves intersect when bycatch is 150 units. Therefore, in this example, the optimum level to the fisherman exceeds the optimum level to society by 135 units and it is the optimum level to the fisherman that determines what bycatch will be. In addition, the fisherman's use of noncost-effective methods to decrease bycatch results in the MCS curve being unnecessarily high. Therefore, had cost-effective methods been used, the optimum level of bycatch for this fisherman from society's perspective would have been less than 150 units.

Bycatch Management Measures Used or Being Considered for Use in the BSAI Groundfish Fishery

Many management measures have been used to control bycatch in the BSAI area groundfish fishery: 1) prohibitions on the retention of specific nongroundfish species which are referred to as prohibited species, 2) time and area closures and seasonal apportionments of groundfish quotas, 3) gear restrictions, 4) groundfish quota allocations by gear type, 5) reductions in groundfish quotas, 6) extensive at-sea and onshore observer programs to monitor bycatch, 7) extensive requirements for reporting catch and product utilization, 8) bycatch limits by fishery for some prohibited species, 9) a vessel incentive program (VIP) with civil penalties for fishing vessels that exceed established bycatch rates for Pacific halibut or red king crab, 10) a community development quota (CDQ) program for walleye pollock, 11) an industry-sponsored voluntary program to fund Pacific salmon bycatch research, 12) required retention of Pacific salmon bycatch until counted by an observer, 13) an industry-sponsored voluntary program that facilitates the retention of bycatch salmon for food banks, 14) individual transferable quota (ITQ) management for the fixed-gear Pacific halibut and sablefish fisheries, 15) target fishery definitions, and 16) careful release regulations for longline fisheries.

The additional measures that are being considered include: a harvest priority program that would reserve part of the groundfish quotas or seasons for vessels that meet specific bycatch standards, regulations that would both prohibit at-sea discards of the major groundfish species and limit the percentage of the catch that is not used to produce products for human consumption, individual transferable bycatch quotas, multispecies ITQ management in which groundfish and nongroundfish quotas would be monitored in terms of total catch, not simply retained catch, and methods to decrease the time between capture and release of Pacific halibut in groundfish trawl fisheries.

Conclusions

The conceptual framework presented above addresses the source and nature of the bycatch problem. This framework can be used to evaluate alternative bycatch management measures even when accurate estimates and projections of all costs and benefits are not feasible. Such an evaluation considers the expected effects of a management measure on the external benefits and costs that result in fishermen making decisions concerning bycatch that do not reflect society's perspective.

Based on this conceptual framework, the following conclusions can be reached: 1) for society, the optimum level of bycatch is not zero unless the benefit of eliminating the last unit of bycatch equals or exceeds the cost, 2) individual fish-

ermen make inappropriate decisions concerning bycatch because they do not pay for the opportunity cost of using fish as bycatch and because the race for fish in an open access fishery distorts their choice of methods to reduce bycatch, 3) the contribution of commercial fisheries to the well-being of the Nation is decreased further by focusing on a narrow set of alternative uses and ignoring the importance of the distribution of fishing mortality among other uses, 4) physical measures of bycatch are of limited use in comparing the magnitude of the bycatch problem among fisheries because neither the benefit nor the cost of reducing bycatch is the same for all species or even for all fish of the same species, 5) bycatch is a multispecies problem because actions to decrease the bycatch of one species can increase or decrease the bycatch of other species and because the bycatch of one species can affect the status of other species through predator, prey, or other biological interactions, and 6) it is highly unlikely that the use of management measures that limit the choices of fishermen rather than eliminate the externalities will result in cost-effective reductions in bycatch to the optimum levels.

Management measures that eliminate or decrease the externalities that are the source of the bycatch problem have several potential advantages. Often these measures have lower information requirements for fishery management decisionmakers and, in fact, provide information that is required by fishery management decisionmakers. These measures also provide increased incentives for fishermen to use their knowledge and ingenuity to decrease bycatch effectively and efficiently. These measures tend to encourage technological improvements. Finally, these measures can decrease the need for ongoing regulatory changes when fishery conditions and optimum levels of bycatch change. Unfortunately, enforcement and transaction costs may be substantially greater for a management measure that effectively eliminates the external benefit of reducing bycatch than for a measure that limits the bycatch choices of fishermen.

A careful evaluation of the tradeoffs between these two types of measures is required to identify the appropriate mix of bycatch management measures. In making such an evaluation, it should be recognized that bycatch and many other management problems have a common source and therefore the benefit of reducing the bycatch problem could include the benefit of reducing several other management problems. The common source of these problems is that individual fishermen do not pay the opportunity cost of the fish and other LMR's they use. In evaluating alternative bycatch management measures, it is also important to recognize that, in the fishery management decision-making process, the effects on the distribution of net economic benefits can be at least as important as the effects on the magnitude of net economic benefits. However, failure to take advantage of the conclusions drawn from this conceptual model can result in unnecessarily high costs to some groups to provide a given increase in benefits to another group.

Chapter 4

The West Coast Regional Report

The Commercial Harvesting Sector

The fisheries off California, Oregon, and Washington involve a wide variety of species and several different types of fishing gear. Table 4-1 provides an overview of participation in west coast fisheries, and shows the ex-vessel revenues and landings per vessel. This table reflects all domestic west coast commercial, nontribal landings, including catch from this region that did not occur within the EEZ.

Throughout the period 1984-93, highly variable prices and revenue potential in many non-groundfish fisheries encouraged most full-time fishing vessels operating off the west coast to develop diversified fishing strategies. Most of the major west coast fisheries, other than groundfish, are subject to cyclical or erratic fluctuations in total value. In the important salmon, shrimp, tuna, and crab fisheries, it is not uncommon for annual revenue to increase by 40-100% or decrease by 25-70% from one season to the next. Sometimes these fluctuations are the result of changes in abundance or availability, while in other years dramatic price changes are responsible.

Although groundfish have represented a generally more stable source of income than other species, groundfish prices and income potential have frequently been more modest than in some of the other fisheries. As a result, abundance and prices in the salmon, shrimp, tuna, and crab fisheries have traditionally played an important role in determining the level of fishing effort directed towards groundfish. This interdependence between fisheries emphasizes the need for management strategies that recognize the potential impact of regulation in one fishery on others.

Because of the general lack of effective limited entry programs for west coast fisheries, high prices or abundance in any given year in a particular fishery tend to draw many new or previous participants into the "booming" fishery. The cycle of participation is sometimes seasonal, with vessels moving from one target fishery to another throughout the year. In other cases, vessels react to longer term changes in stock abundance or prices by shifting effort towards or away from certain fisheries for a given year. During periods without a "boom" fishery, many marginal participants exit from fishing entirely. These observations are, by necessity, very general in nature. As a result of limited data availability and staffing resources, the relationships involved in west coast product demand or vessel participation have rarely been quantitatively examined.

Figure 4-1 shows a breakdown of the number of vessels harvesting in west coast fisheries between 1984 and 1993. A distinction is made between those vessels whose landed catch exceeded three different threshold amounts—1 pound, 2 metric tons (t), and 25 t. Over 90% of the vessels landed less than 25 t each year; approximately 60% of the vessels landed less than 2 t.

In general, west coast vessels with a higher level of production are characterized by a greater degree of diversity in their fishing operations. As one measure of diversity, the number of different fisheries in which a vessel participated is considered. Of approximately 26,800 unique vessels participating in west coast fisheries between 1984 and 1993, 68% had less than 10 t of landings. Of these, 95% participated in fewer than three fisheries. In contrast, of the remaining 32% of vessels

West coast fishing vessels near Fishermen's Terminal, Seattle (NMFS photo by Joni Packard).

(i.e., those with more than 10 t of landings), only 43% participated in fewer than three fisheries, and 24% had landings in at least five fisheries. In addition to the diversity that is reflected in vessels' participation in multiple west coast fisheries, some segments of this fleet, such as hook and line boats and offshore delivery vessels, also participate in fisheries off the coast of Alaska.

Management

The Pacific Fishery Management Council (PFMC) currently oversees three FMP's that govern fisheries for groundfish, salmon, and anchovies. The groundfish FMP includes various species of flatfish, rockfish, and groundfish, such as sablefish and Pacific whiting. The salmon plan focuses upon chinook and coho stocks that breed in freshwater streams from northern California to the Canadian border. The annual percentages of salmon and groundfish taken in PFMC-managed waters are shown in Figure 4-2. Discussions of developments specific to these two FMP groups are provided in the following two sections. The anchovy fishery is minor, accounting for less than 4,000 t in landings and less than $1 million in annual ex-vessel revenues since 1984. Because of the small magnitude of this fishery, and considerations of funding, mandated regulatory reduction, and need, the Council is currently considering abandoning this FMP.

Groundfish

The west coast groundfish fishery has undergone several major changes since the implementation of the MFCMA. Prior to 1979, most of the groundfish caught off the west coast was harvested by foreign fishing vessels (Fig. 4-3). The principal targets for most foreign operations were either Pacific ocean perch or Pacific whiting, an abundant, low unit-value pelagic species. Both species are now managed under the PFMC's Groundfish FMP. By 1979, foreign and domestic catches were roughly the same, though domestic landings consisted of generally higher-valued species. Following implementation of the MFCMA, an increasing percentage of west coast groundfish was caught by domestic vessels. Initially, much of this new domestic effort came in the form of joint-venture arrangements with foreign processing ves-

Table 4-1

Average annual ex-vessel revenue per vessel in real dollars (1987=100), landings per vessel in round weight (pounds), real ex-vessel price, and number of vessels participating in west coast fisheries, for all vessels with some landings in the specified west coast species group, 1984-93[1].

Species	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Groundfish										
Revenue	7,058	7,324	7,043	7,411	6,975	6,471	6,212	7,362	7,171	7,189
Landings	26,146	24,750	22,107	20,839	21,051	21,613	21,715	24,129	24,354	25,720
Prices	0.27	0.30	0.32	0.36	0.33	0.29	0.28	0.31	0.30	0.28
Vessels	7,822	8,458	9,055	10,547	9,932	10,398	9,796	8,740	8,683	7,721
Whiting										
Revenue	7,807	14,867	10,319	17,141	20,611	25,130	20,326	31,561	95,162	46,739
Landings	153,935	309,323	216,726	349,881	344,096	495,665	398,403	709,054	2,414,531	1,877,187
Prices	0.05	0.05	0.05	0.05	0.06	0.06	0.05	0.04	0.04	0.02
Vessels	96	94	119	111	85	69	52	73	53	50
Salmon										
Revenue	5,014	5,879	7,273	11,843	14,605	6,559	5,824	4,446	3,553	3,972
Landings	3,129	5,261	5,660	6,733	7,150	5,471	3,995	5,204	3,534	5,206
Prices	1.60	1.11	1.29	1.76	2.04	1.20	1.46	0.86	1.01	0.76
Vessels	5,867	7,908	7,945	7,396	7,301	7,415	6,594	5,829	4,141	4,149
Crab										
Revenue	16,059	17,388	16,290	16,181	22,589	20,911	23,125	11,317	18,860	21,604
Landings	9,877	11,817	11,861	12,133	20,101	20,150	17,434	8,888	19,639	23,898
Prices	1.63	1.47	1.37	1.33	1.13	1.04	1.33	1.27	0.96	0.91
Vessels	1,706	1,701	1,657	1,822	2,004	1,919	1,936	1,877	1,872	1,728
Shrimp										
Revenue	18,459	33,141	72,220	95,928	60,406	59,586	55,621	42,674	54,605	31,236
Landings	32,379	81,129	126,815	138,204	144,452	169,075	121,227	84,717	175,572	99,362
Prices	0.57	0.41	0.57	0.69	0.41	0.35	0.46	0.50	0.31	0.32
Vessels	332	351	466	498	501	472	467	527	459	526
Shellfish										
Revenue	16,155	5,917	8,728	9,110	7,463	8,463	12,295	12,792	37,166	38,061
Landings	21,299	3,571	3,696	14,620	14,246	8,019	12,890	13,079	15,509	15,371
Prices	0.76	1.65	2.36	0.62	0.52	1.05	0.95	0.98	2.40	2.48
Vessels	238	531	237	388	378	532	324	302	154	215
Coastal pelagic										
Revenue	26,613	20,208	27,867	18,476	20,768	17,229	9,501	18,794	10,221	8,496
Landings	296,816	238,945	353,716	279,865	284,282	257,260	172,751	309,779	172,489	192,282
Prices	0.09	0.08	0.08	0.07	0.08	0.06	0.05	0.06	0.06	0.04
Vessels	414	426	341	446	454	529	613	323	507	336
Tuna										
Revenue	58,613	24,853	38,870	85,220	92,251	82,801	37,814	40,194	21,176	24,857
Landings	119,249	60,712	88,694	86,369	98,915	93,813	49,700	55,739	32,828	41,592
Prices	0.49	0.41	0.43	0.99	0.93	0.88	0.76	0.72	0.65	0.60
Vessels	1,524	1,156	772	974	836	620	809	362	867	822
Sea urchin										
Revenue	18,911	22,776	33,748	30,614	34,714	40,307	39,536	51,658	46,127	43,642
Landings	71,634	90,297	116,474	106,650	99,003	97,227	83,691	78,317	61,631	52,814
Prices	0.26	0.25	0.29	0.29	0.35	0.41	0.47	0.66	0.74	0.83
Vessels	216	229	307	471	657	652	672	739	718	682
Squid										
Revenue	5,048	25,355	32,013	29,791	52,590	55,270	38,832	58,427	20,863	68,977
Landings	19,989	144,948	321,452	331,261	569,998	771,366	580,613	930,018	292,100	792,955
Prices	0.25	0.18	0.10	0.09	0.10	0.07	0.07	0.06	0.07	0.09
Vessels	111	166	146	133	144	117	108	89	99	119
Herring										
Revenue	6,173	17,357	14,709	15,683	14,845	12,399	27,538	27,357	26,434	4,472
Landings	18,782	37,923	41,608	48,193	48,735	52,697	57,813	54,700	52,244	38,860
Prices	0.33	0.46	0.35	0.33	0.31	0.24	0.48	0.50	0.50	0.11
Vessels	403	416	425	417	435	423	318	331	304	252
Pacific halibut										
Revenue	5,415	12,572	14,704	13,320	14,036	17,169	6,992	5,561	3,065	4,299
Landings	5,852	9,663	8,462	6,115	8,266	10,047	3,128	2,287	1,845	2,674
Prices	0.92	1.30	1.73	2.18	1.69	1.71	2.23	2.43	1.66	1.61
Vessels	239	273	367	365	261	224	201	206	218	294
Other										
Revenue	8,180	10,146	9,409	7,978	7,239	8,189	6,852	6,065	6,084	6,611
Landings	6,650	8,747	8,153	6,015	5,732	6,707	7,021	5,475	5,942	4,822
Prices	1.23	1.17	1.16	1.33	1.26	1.22	0.97	1.10	1.03	1.37
Vessels	2,678	2,379	2,511	2,607	2,700	2,623	2,526	2,377	2,349	2,183

[1]Included are landings of fish caught inside state waters, but not catch by recreational or tribal fishermen. Source: Redefined PacFIN data base, Seattle Office of the Pacific States Marine Fisheries Commission, 7600 Sand Point Way N.E., BIN C15700, Seattle, WA 98115-0070.

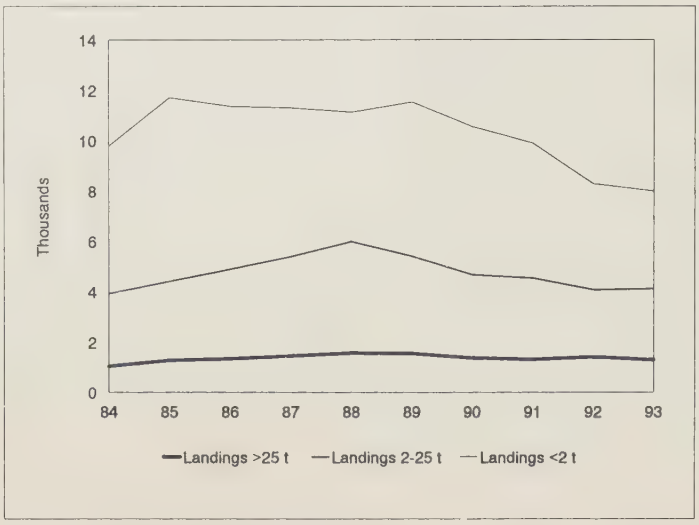


Figure 4-1
Number of west coast vessels, by landings category.

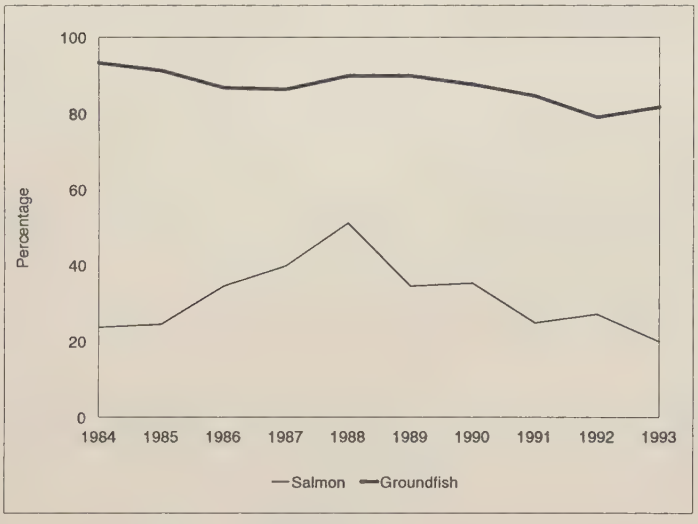


Figure 4-2
Percentage of Pacific coast salmon and groundfish caught in PFMC-managed areas (includes only commercial, non-tribal shoreside landings).

sels. Following exploratory fishing for Pacific whiting by a few U.S. factory trawlers in 1990, the rapid entry of many domestic factory trawlers and motherships in 1991 rendered foreign processing unnecessary for the harvest of more than 200,000 t of whiting. As shown in Figures 4-3 and 4-4, the foreign fleet, which had processed at least 150,000 t of whiting during each of the previous 5 years, was provided with no further allocation for processing any species after 1990.

West coast factory trawler near Fishermen's Terminal, Seattle (NMFS photo by Joni Packard).

After 5 years of development by the PFMC, a license limitation program was implemented in 1994 for the west coast groundfish fishery. Individual transferable quotas were not considered at length for the groundfish fishery as a whole because of identified problems in implementing them in a multi-species trawl fishery without observers routinely aboard vessels. Permits were issued to individuals based on the catch history of their vessels, and included gear and vessel-length eligibility. Gears endorsed for use in the program were trawl, longline, and pot. The program allows permits to be combined, according to a formula, in order to facilitate the permitting of large vessels.

Alongside the limited entry fishery for groundfish, the PFMC elected to maintain an open-access fishery, open to any previously legal groundfish gear except trawls. The allocation of particular species to the open access fishery is based on the percentage of landings during the qualifying window by vessels not qualifying for permits. In addition to pot and longline gear, most of these fish are caught with other line gears, set nets, or with shrimp trawling gear.

From 1984 to 1993, the annual number of vessels landing groundfish peaked at 4,364 in 1987, and has declined steadily since then to 2,850. However, this trend is more indicative of the reduction in the size of the salmon fleet, which has accompanied reductions in salmon quotas since 1988, than it is of reductions in the most productive ranks of the groundfish fleet. Within the three limited entry gear groups, the number of vessels landing more than 1 t of groundfish has stayed roughly the same for those using trawl or pot gear, but has doubled for those using line gear. This upward trend for line-gear vessels is apparent for

threshold levels as high as 25 t of annual landings. However, at a threshold of 50 t of landings, the number of vessels has declined for all gears since 1987, primarily due to reductions in availability of some economically important species.

While the number of vessels fishing for groundfish has not, on the whole, increased dramatically over the last 10 years, the combination of increases in vessel harvesting capacity and the fishing down of some key stocks to or below MSY levels has led to greater difficulty in managing and participating in the groundfish fishery.

For the trawl fishery, the PFMC has established an objective of maintaining a year-round fishery. This objective reflects the need for processors to maintain a domestic fresh-market presence with many species, as well as concerns regarding social and employment stability in coastal communities. In an attempt to extend fishing opportunities throughout the year, the PFMC has recommended an elaborate system of trip/landing limits designed to restrict vessel output. These limits have evolved from very rudimentary single-species limits on individual trips to the current restrictions that take the form of cumulative monthly limits, some of which relate single species catch to that of a larger assemblage. Following the recent implementation of a means of controlling entry into this fishery, the PFMC has begun to consider possibilities for individuals to gain access to multiple monthly limits through the purchase of additional permits.

No factory trawlers were initially issued permits under the license limitation program, because the qualifying window predated their involvement in the fishery. And despite the fact that nine factory trawlers now have permits, obtained through the purchase of roughly 100 trawl permits (out of 390), both the whiting fishery and those for other groundfish species remain highly overcapitalized. The offshore fleet, which harvested roughly 180,000 t in 1994, has demonstrated the ability to catch at least 35,000-40,000 t of whiting per week. In the remaining groundfish fishery, many trawlers reach their cumulative limits by fishing only 2 weeks per month throughout much of the year. These statistics provide some evidence that license limitation programs (or limited entry) alone cannot prevent overcapitalization.

Pot gear is used in the groundfish fishery primarily to target sablefish, which is also the principal target for a large segment of the longline fleet.

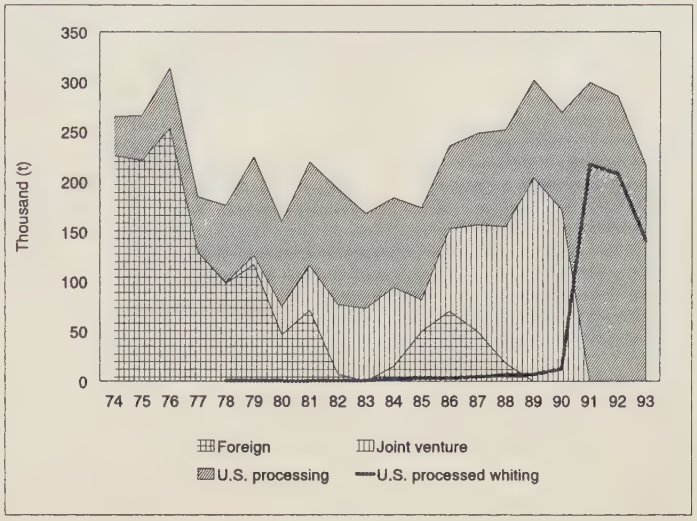


Figure 4-3
Catch of Pacific coast groundfish (includes discards from foreign, joint venture, and U.S. at-sea processors, but not catch from tribal or recreational fishers).

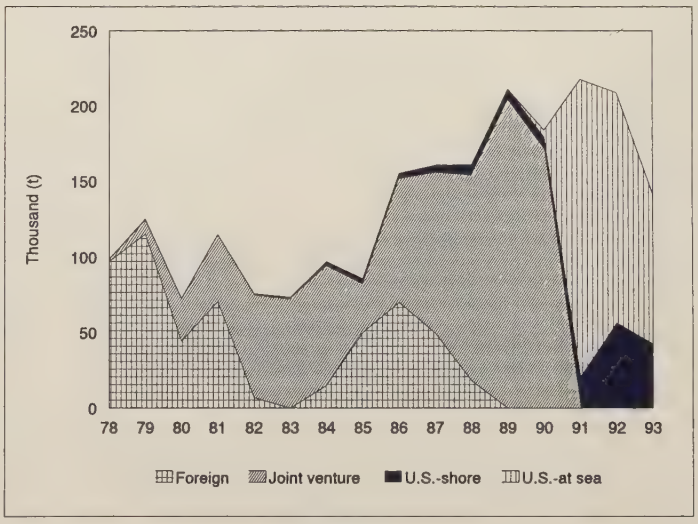


Figure 4-4
Catch of Pacific whiting (includes discards from foreign, joint venture, and U.S. at-sea processors, but not catch from tribal or recreational fishers). 1993 data are preliminary.

Because this fish is predominantly exported in frozen form, providing a year-round fishery was not a high management priority. Although the sablefish season was open year-round in 1984, by 1992 the fixed-gear (pot and longline) season for sablefish had been reduced to roughly 2 weeks. And despite reducing the number of participants from more than 300 to about 120, license limitation in 1994 was only successful in adding 1 week to the

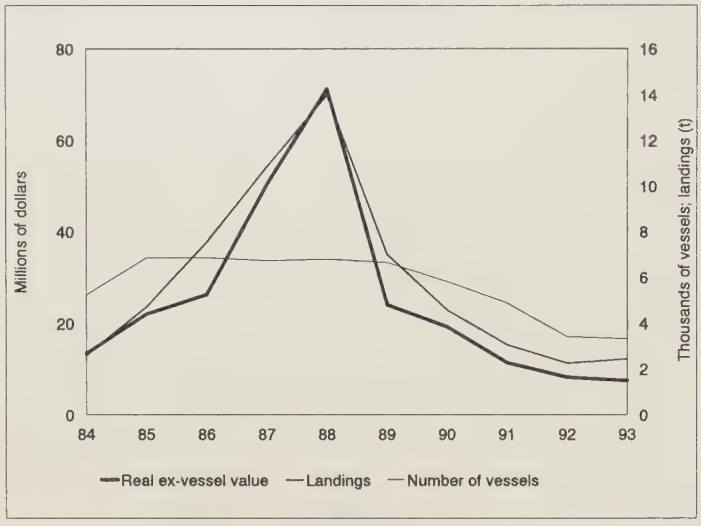


Figure 4-5
Ex-vessel value, landings, and number of vessels harvesting chinook salmon (includes landings of fish caught inside state waters).

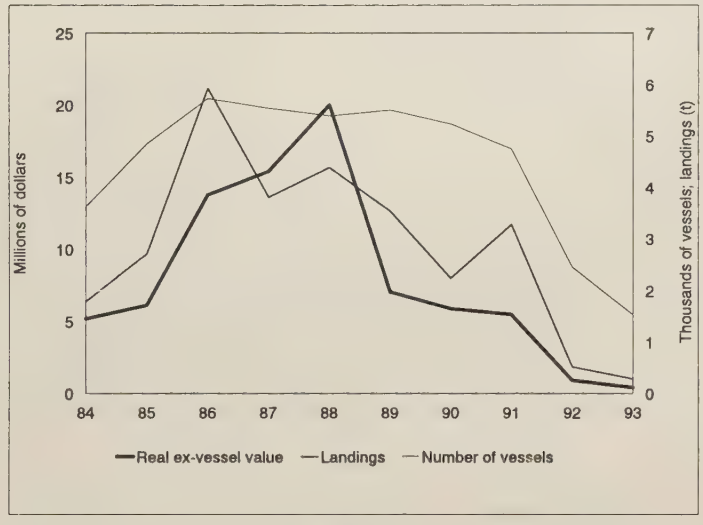


Figure 4-6
Ex-vessel value, landings, and number of vessels harvesting coho salmon (includes landings of fish caught inside state waters).

length of the 1992 season, proof of overcapitalization in this fishery, as well as further validation that licenses do not provide the proper incentives for using the efficient levels of capital in fisheries. Beginning in 1992, the PFMC spent more than 2 years developing a proposal for introducing a system of ITQ's into this fishery. However, they tabled further consideration of this approach in the fall of 1994, citing concerns over the allocation of resource rents and the magnitude of projected administrative and enforcement costs relative to potential benefits.

Salmon

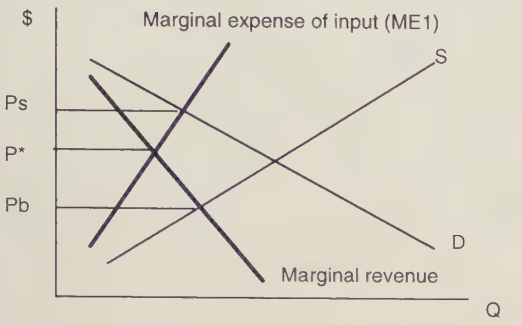
The west coast commercial, nontribal salmon fisheries underwent tumultuous change during 1984-93. This period's high-water marks for landings, price-per-pound, revenue, and average revenue per participant occurred in 1988. Total salmon ex-vessel revenue increased by more than a factor of three between 1984 and 1988 (and by a factor of six for salmon caught within the EEZ). However, by 1992-93, landings and prices had both fallen to levels below those observed in 1984. The number of vessels earning the largest share of their income from salmon fishing rose from less than 4,900 in 1984 to 6,500 in 1988, and has since fallen to just over 3,300. Figures 4-5, 4-6, and 4-7 display the commercial, nontribal salmon landings, ex-vessel value, and number of vessels fishing for chinook, coho, and other salmon species, respectively.

A variety of factors have contributed to the instability evidenced by salmon populations in this region over the past 10 years. Foremost among these factors are spawning habitat inaccessibility or degradation, which has accompanied the presence of dams and other land-use practices, and large-scale ocean environmental fluctuations such as the recurrent El Niño phenomenon. Additionally, the problem of migrational mortality at dam sites has been exacerbated by cyclical drought conditions occurring throughout the Pacific Northwest.

The reductions observed in salmon escapement since 1988 have led to the listing of four stocks as endangered (Snake River sockeye salmon and Sacramento River winter-run chinook) or threatened (Snake River spring/summer chinook and Snake River fall chinook), under the provisions of the Endangered Species Act. These listings and the potential for additional stocks to be listed have had considerable impact on the management and utilization of other, healthier salmon stocks as well as some groundfish fisheries.

The Seafood Processing Sector

Over the past decade, relatively little comprehensive research has been undertaken



Bi-lateral monopoly: one seller (fishing vessel association) and one buyer (monopsony ex-vessel fish buyer). Price will be negotiated and will fall somewhere between the monopoly price (Ps) and the monopsony price (Pb). Economic theory states that the amount traded would be less than that traded under perfect competition, but perfect competition is unlikely in the context of an open access fishery.

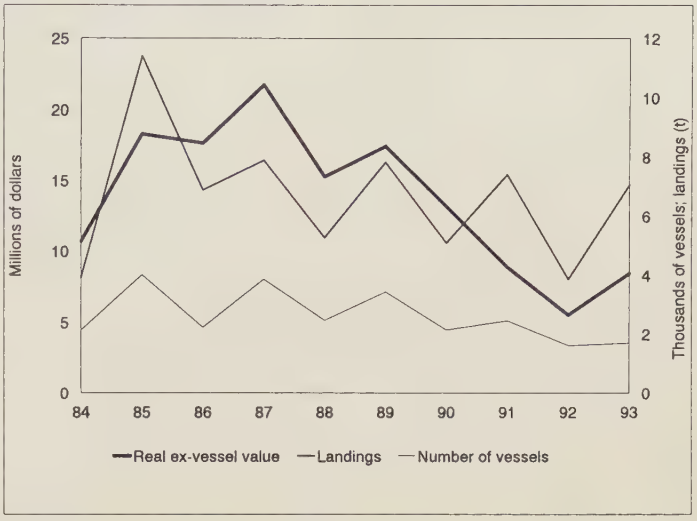


Figure 4-7
Ex-vessel value, landings, and number of vessels harvesting other salmon.

regarding the west coast seafood processing sector. Current management issues relating to the PFMC's goal of maintaining year-round groundfish fishing opportunities, in the face of lower stocks and greater effort, suggest the need for a more in-depth examination of processor activities. Seafood processing on the west coast involves several types of firms which vary widely in terms of the range of products they produce, their relative dependence on imported vs. local raw seafood input, and other products produced within the same conglomerate. This section provides a picture of the major components of the current (1991-93) west coast processing industry and describes the major changes that have occurred over the decade from 1984 to 1993.

Processors that buy fish directly from west coast vessels can be divided into five rather distinct groups: canneries (tuna, pet food, salmon, squid, sardines), at-sea Pacific whiting processors, sea urchin and sea cucumber processors, Pacific herring processors, and combination processors handling salmon, crab, shrimp, groundfish, pelagic fish, squid, and sometimes sea urchins or herring. There is some overlap among these categories, but most fish buyers of any significance clearly fall into one of the groups. In addition to these processors, there are those that import fish or fish products (surimi) for further processing (e.g., into breaded sticks and portions or imitation crab meat), but are not reflected in the landings database because they do not buy directly from vessels landing on the west coast.

Almost all west coast landings of shrimp, crab, salmon, and groundfish (accounting for 58% of the ex-vessel value of all marine fish landed on the west coast in 1993), were processed by multi-species, multi-product processing plants. The species mix handled by these plants has not changed much over the last ten years, except for the large expansion of Pacific whiting landings in Oregon beginning in 1991. In 1993, the five largest processors of this type accounted for 45% of the shrimp, crab, salmon, and groundfish landings. Most of the significant ports have two or more processing firms purchasing these species from vessels, either at processing plants or buying stations. The fish purchased at buying stations are trucked to other sites for processing. The existence of localized monopsony power is a definite possibility, but has not been investigated. In the event it does exist, it is probably largely offset by the fishing vessel associations active in price negotiations with processors throughout the coast.

Figure 4-8 provides an annual overview of the number of licensed buyers who purchased landings on the west coast, along with the average tons purchased per buyer and average real ex-vessel value of landings per buyer. The complete list of buyers includes a very large number who do not represent the core of the processing industry. For purposes of identifying the general size of the core group, a threshold of 25 t was set, and the average tons purchased and average real value of

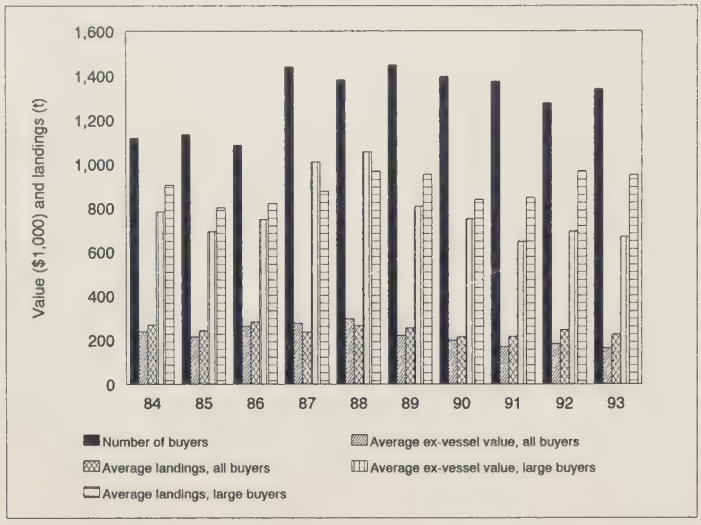


Figure 4-8
Average ex-vessel volume and value of all west coast buyers vs. "large" buyers ("large" refers to those buyers who receive more than 25 t).

Table 4-2
West coast processed fishery product output per employee, 1984-93[1].

Year	Average no. of employees	Output (t)	Output (t) per employee	Real value of output ($1,000)	Real dollars per employee
1984	9,513	304,620	32.0	707,043	74,324
1985	7,743	205,027	26.5	483,407	62,431
1986	8,288	195,335	23.6	590,749	71,278
1987	8,547	233,051	27.3	773,874	90,543
1988	9,156	378,051	41.3	984,239	107,497
1989	9,343	383,898	41.1	965,927	103,385
1990	10,817	351,042	32.5	1,100,975	101,782
1991	11,882	415,846	35.0	1,328,200	111,783
1992	11,562	403,627	34.9	1,136,024	98,255
1993	11,145	447,785	40.2	1,201,386	107,796

[1]Source: NMFS Annual Survey of Processed Fish Products.

landings per buyer was calculated. These trends are also shown in Figure 4-8. Average annual real ex-vessel purchases by those buyers receiving at least 25 t ranged from $647,000 to $1,054,000 over the period 1984-93.

There were 315 buyers in the core group in 1993, or about 24% of the total number of licensed buyers. However, this core group accounts for 99% of the fish landed, by weight. The core group of buyers is composed primarily of fish processors, although many processing firms have multiple buyer codes. After combining all buyer codes associated with the same parent firm, the top 10% of firms in terms of sales (129 firms) account for 87% of the ex-vessel value of all fish landed on the west coast in 1991.

Table 4-2 shows average employment, output in metric tons, real revenues, and output per employee for west coast processors. Because of variations in the response rate from year to year in the NMFS survey, the industry-wide levels of employment and output are not always reliable. However, the output/employee ratios are not as sensitive to response rates. These figures indicate a modest upward shift in output per person over the last decade.

The most significant development in the west coast fish processing industry over the last decade has been the growth of domestic production of analog products (e.g., imitation crab meat) from surimi. The surimi used is mostly produced from Alaska pollock, by floating and shorebased processors in Alaska, although a small number of processors use surimi produced from Pacific whiting (hake). The revenues from reported analog production on the west coast grew from zero in 1984 to $135.7 million in 1993. Revenues from west coast production of surimi during that period grew from zero to $29.1 million. It is not known how much

In addition to the NMFS Annual Survey of Processed Products (described in this report's Introduction and Overview), the west coast has a second source of data with which to analyze the structure of its processing industry. This is the fish landing receipt system managed by the three west coast states and integrated into the Pacific Fisheries Information Network (PacFIN) data retrieval system. These data consist of records of each sale of fish by fishing vessels to processors or other firms or individuals. Fish buyers must be licensed unless they are consumers buying directly from fishing vessels, in which case the vessels must be licensed for over-the-side sales. Each licensed buyer and each vessel licensed to sell over-the-side has a buyer code that is recorded on the fish landing receipt and is incorporated into the PacFIN data base. This data reporting system has more detailed information on the species of fish and where fish were caught than does the NMFS survey. The PacFIN database also has the advantage of being mandatory, so that response rates may be presumed to be high and relatively constant. However, it contains no prices or quantities of output. Furthermore, not all west coast fish buyers are processors, and much of the fish processing activity on the west coast uses fish that are shipped from other regions and therefore is not reflected in PacFIN data.

of this surimi was used in west coast analog production.

Alaska pollock is also used by west coast seafood processors for breaded and battered products. These products have been a substantial part of fish processing activity throughout the decade, although they have not shown the consistent, rapid growth of analog products. The real wholesale value of reported output of breaded and battered products on the west coast has fluctuated substantially, with a low in 1989 of $75.6 million and a high in 1993 of $131 million.

The period 1984-93 also saw very significant changes in the processing of Pacific whiting. In 1984, the total Pacific whiting harvest was approximately 115,000 t, of which 2,700 t were processed on shore by U.S. processing firms. The remaining 112,300 t were processed by foreign floating processors engaged in joint ventures or directed foreign fishing. By 1993, all harvest was processed by U.S. firms, with 30% processed in onshore plants and the remaining 70% processed at sea.

West coast fish canning has been dominated throughout the past decade by southern California tuna and pet food canners. The principal sources of fish have been albacore from west coast ports, light meat tuna landed in California, light meat tuna shipped in from areas outside the west coast, and mackerel landed in California. Total revenue from fish products reported by canners responding to the NMFS Annual Survey (including all the large tuna canners) dropped from $267.3 million in 1984 to $73.2 million in 1986. This precipitous decline was due primarily to the closing of two major tuna canneries in California. After reaching its lowest point in 1986, the coastwide reported value of canned fish production steadily rose to a high of $306.3 million in 1993. This was due mostly to a substantial increase in canned tuna production and a very large increase in production of canned pet food from fish products. [See the west coast fisheries spotlight article for a discussion of the canned tuna industry.]

Processing of shrimp has grown rapidly since 1984, with most of the growth taking place in California. West coast landings fluctuated during the decade, but accounted for less than 25% of the revenue generated from shrimp products by 1993. The bulk of the increase comes from processing imported shrimp.

Processing of sea urchin roe for export to Japan has grown rapidly during the decade; the NMFS survey data indicate an increase from no production in 1986 to $73.7 million worth of production in 1993. However, it is not known how accurately the survey reflects what was actually happening in this segment of the processing industry. In 1991, only 20 responding firms indicated any output from sea urchins, but PacFIN data indicate that 99 firms bought sea urchins from Washington, Oregon, and California vessels. Sixty-five sea urchin buyers, accounting for 93% of sea urchin ex-vessel value, purchased almost nothing but sea urchins. Four of these were among the top 25 buyers of fish and shellfish landed on the west coast. The high degree of specialization of these processors may be due to the fact that the product is exported to the very discriminating Japanese market.

The Trade Sector

Due to the way trade data are collected (by Customs district), information on Washington, Oregon, and Alaska imports and exports are combined into one Pacific Northwest report. See Chapter 3, the Alaska regional report, for a discussion of that sector.

The Recreational Sector

Summary Statistics

This section presents an overview of the marine recreational fishing sector in California, Oregon and Washington[1]. About 3.1 million marine anglers made 11.1 million fishing trips and landed 28.1 million fish annually during 1983-89 on the Pacific coast (Fig. 4-9—4-12). The distribution of anglers among southern California, north-

[1]All estimates of nonsalmon harvest and effort contained in this report were obtained from the Marine Recreational Fishery Statistics Survey (MRFSS), described in the national overview section. The MRFSS was conducted annually on the Pacific coast through 1989, discontinued during 1990-92, and resumed in 1993. When the survey resumed, it did not provide complete coverage of the entire Pacific coast fishery; i.e., estimates of effort and harvest for all modes in Washington and estimates of harvest for charter boat mode in northern California are not available for 1993. Estimates of salmon harvest and effort were obtained from the PFMC. Even though these estimates are available as a continuous time series, they are presented in this report only for those years in which estimates of nonsalmon harvest and effort from the MRFSS are also available.

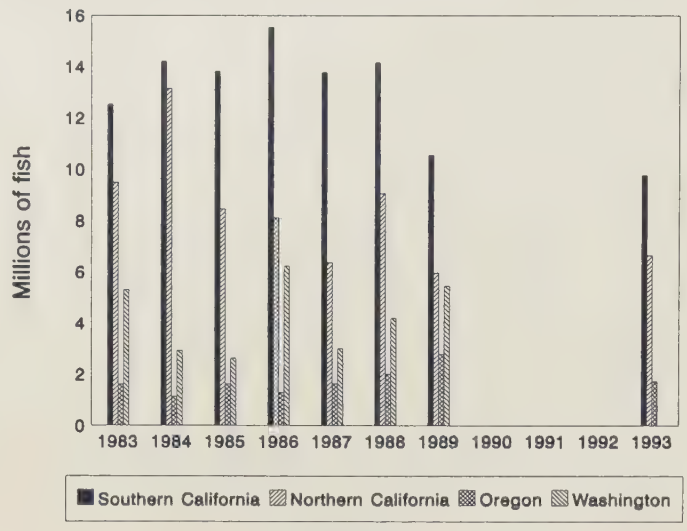


Figure 4-9
Estimated number of fish harvested by West coast recreational fishermen, by state.

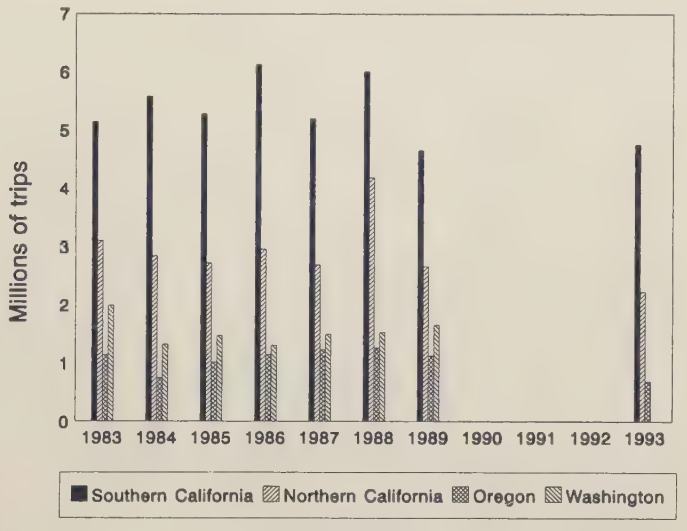


Figure 4-10
Estimated number of recreational fishing trips on the West coast, by state.

ern California, Oregon, and Washington (47%, 30%, 10%, and 13%, respectively) closely approximated the geographic distribution of fishing trips (49%, 27%, 10%, 14%) and total harvest (48%, 31%, 6%, 15%). A comparison of the average annual number of anglers during 1983-89 with the number of anglers in 1993 suggests a general decline in angling participation in recent years, at least in California and Oregon. The average annual number of angler trips during 1983-1989 was also consistently higher than the number of angler trips in 1993 for all modes in California and Oregon, with the notable exception of charter boat trips in southern California.

Total annual harvest also declined from 1983-89 to 1993 for all modes in California and Oregon, except for private boats in northern California and charter boats in Oregon. This decline in harvest may be due to shifts in the distribution of trips among target species as well as a decline in effort. For instance, since catch rates tend to be substantially higher for rockfish trips than salmon trips, an increase in the proportion of total trips targeted at rockfish may result in an increase in total harvest, even if total effort remains the same. The distribution of average annual harvest among fishing modes (35% shore, 30% charter boat, and 35% private boat) differed somewhat from the distribution of trips (39% shore, 16% charter boat, and 45% private boat) during 1983-1989. The disproportionate representation of charter boat harvest relative to trips indicates higher catch rates for charter boats relative to the other modes.

The species composition of harvest tends to vary among areas and fishing modes. For instance, salmon are rarely caught in southern California, while sea bass and mackerel/tuna are rarely caught anywhere else on the Pacific coast except southern California. Surfperch is commonly caught from shore, while rockfishes constitute a major component of harvest in the boat-based modes (Tables 4-3a–3c). The importance of a species to the fishery in terms of the number of trips is not necessarily reflected in its contribution to total harvest. For instance, salmon was the primary target on 26% of all charter boat trips in northern California during 1983-89 but comprised only 5% of total annual charter boat harvest in those years. This same disproportionality between salmon trips and salmon harvest occurs in other areas and modes as well (Table 4-4). In Oregon, the proportion of total charter boat trips targeted at salmon declined from 45% to 14% and the contribution of salmon to total charter boat harvest declined from 16% to 2% from 1983-89 to 1993. Similarly, the proportion of total private trips targeted at salmon declined from 29% to 16% and the contribution of salmon to total private boat harvest declined from 29% to 9% from 1983-89 to 1993. However, no similar trend was observed for private boat fishing in northern California.

West coast sport fishing boats at Ilwaco, Wash. (NMFS photo by Steven Freese).

During 1983-89, non-residents contributed more to the angling population than to angler trips, averaging 1.5 trips per year, compared to 4.1 trips per year for resident anglers. About 6% of shore trips, 16% of charter boat trips, and 5% of private boat trips on the Pacific coast during 1983-89 were made by non-resident anglers.

Expenditures and Economic Value

Anglers spend about $848.6 million annually for sport fishing on the Pacific coast—about 43% for equipment and 57% for trip-related expenditures (Table 4-5). Total equipment expenditures are based on the annual average number of resident anglers during 1983-89 and on available estimates of per capita equipment expenditures (U.S. Fish and Wildlife Service and U.S. Bureau of the Census, 1993a, b, c). Equipment expenditures by nonresident anglers are not attributed to Pacific coast fishing, since these anglers do most of their fishing elsewhere and are more likely to purchase equipment in their home states.

Total trip expenditures of $486.1 million are based on the average annual number of fishing trips made during 1983-89 and on available estimates of expenditures per trip. The level of detail of these estimates varies by region and is determined by the level of detail provided by available per trip estimates. Thus total trip expenditures are broken down by fishing mode and residency of angler for southern California, by fishing mode for northern California, and by residency for Oregon and Washington.

Aggregate angler consumer surplus (ACS) cannot be estimated for the entire Pacific coast, since estimates of consumer surplus per trip are available only for selected areas, modes, and species.

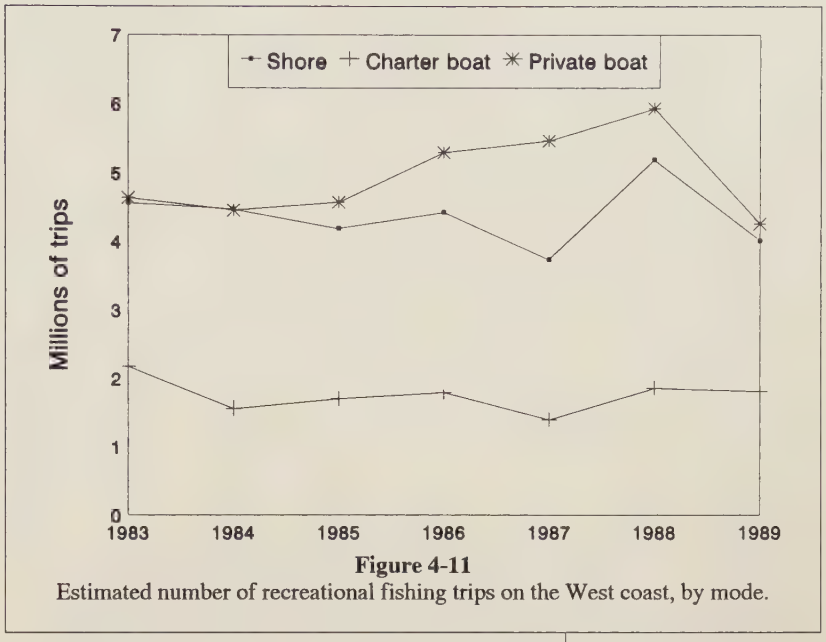


Figure 4-11
Estimated number of recreational fishing trips on the West coast, by mode.

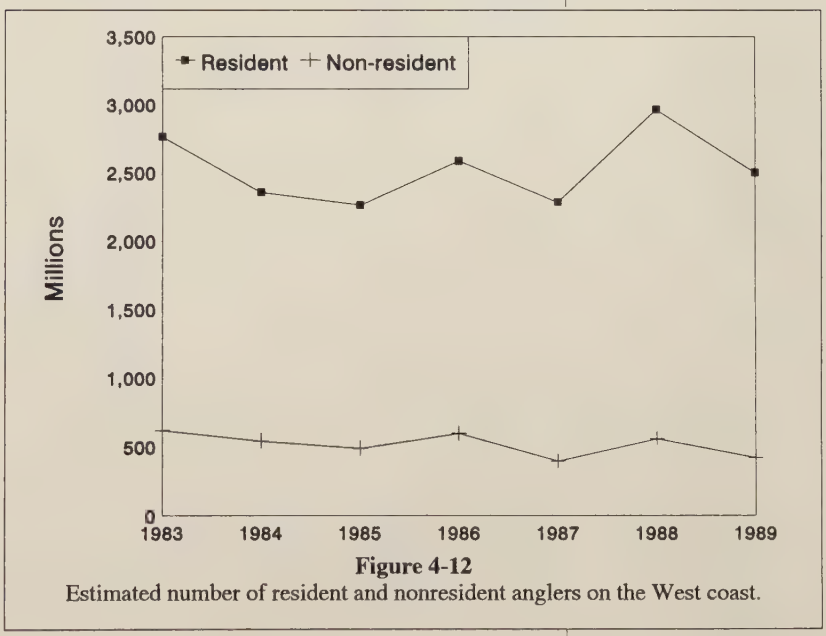


Figure 4-12
Estimated number of resident and nonresident anglers on the West coast.

The available estimates, however, do suggest that ACS is a significant component of total willingness-to-pay (WTP) for recreational fishing experiences (WTP is the sum of consumer surplus and expenditures). For instance, ACS per trip in southern California has been estimated at $79.65 for charter boat trips and $27.07 for private boat trips (Hanemann et al., 1989); these values are comparable in magnitude to expenditures per trip for southern California ($68.64-$97.32 for charter boat trips and $50.44-$94.82 for private boat

Table 4-3a
Average annual 1983-89 distribution of finfish harvest in shore mode in California, Oregon, and Washington, by species group and region[1].

Species group	Southern California	Northern California	Oregon	Washington
Croaker	18%	4%	0%	0%
Surfperch	15%	23%	31%	12%
Smelt	3%	41%	21%	60%
Mackerel/tuna	30%	1%	0%	0%
Rockfish	10%	9%	13%	7%
Silversides	7%	4%	0%	0%
Herring	0%	4%	9%	6%
All other species	18%	14%	26%	16%

[1]Columns may not add up to 100% due to rounding of data.

Table 4-3b
Average annual 1983-89 distribution of finfish harvest in charter boat mode in California, Oregon, and Washington, by species group and region[1].

Species group	Southern California	Northern California	Oregon	Washington
Sea bass	17%	0%	0%	0%
Mackerel/tuna	28%	4%	0%	0%
Rockfish	35%	67%	56%	38%
Salmon	0%	4%	15%	12%
Smelt	1%	2%	9%	17%
Cod/hake	0%	0%	1%	20%
All other species	19%	22%	20%	13%

[1]Columns may not add up to 100% due to rounding of data.

Table 4-3c
Average annual 1983-89 distribution of finfish harvest in private boat mode in California, Oregon, and Washington, by species group and region[1].

Species group	Southern California	Northern California	Oregon	Washington
Sea bass	18%	0%	0%	0%
Mackerel/tuna	27%	3%	0%	0%
Rockfish	31%	60%	39%	28%
Salmon	0%	3%	27%	6%
Flatfish	3%	7%	1%	12%
Shark	1%	2%	0%	13%
Cod/hake	0%	0%	0%	23%
Croaker	9%	10%	0%	0%
Surfperch	1%	3%	13%	1%
All other species	11%	12%	21%	17%

[1]Columns may not add up to 100% due to rounding of data.

trips). Multiplying the number of angler trips for charter and private boats by their respective per trip ACS yields a total value of recreational fishing in southern California of $173 million (which excludes the value of shore-based trips).

Regulations

State regulations generally require that anglers who have reached a specified age (16 years in California, 14 years in Oregon, and 15 years in Washington) obtain a state angling license (CDFG, 1994; ODFW, 1995; WDFW, 1994). Each state also imposes restrictions on gear, seasons and areas fished, as well as size and bag limits. Some of these restrictions apply to all marine fishing, while others are species- or area-specific.

Management Issues

Most of the major management issues faced in the three Pacific coast states involve allocation of nearshore fishing opportunities between sport and commercial fishermen. These issues have typically taken the form of direct allocation or management measures which have an indirect allocative effect. Some of the states' actions have involved consultation with the PFMC to determine consistency of state regulations with the Federal Groundfish Management Plan, and have generated considerable discussion and controversy at the PFMC as well as at state levels.

In 1990, California voters passed Proposition 132, which banned the use of commercial set nets to harvest rockfish in state waters. In the same year, concerns regarding depletion of black rockfish prompted Washington to close major charter boat fishing areas to commercial jigboats and reduce the sport bag limit for rockfish. Oregon enacted similar measures in 1993, and Washington reduced its rockfish bag limit a second time this year. In 1988, the Washington Legislature banned commercial trawling in urbanized areas, and extended that ban in 1994 to other areas as well. Washington is now considering a ban on all commercial bottomfishing within its 3-mile jurisdiction.

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Table 4-4
Average 1983-89 and 1993 contribution of salmon to total trips and total catch in northern California, Oregon, and Washington, by fishing mode and area.

	Northern California		Oregon		Washington	
	Charter boat	Private boat	Charter boat	Private boat	Charter boat	Private boat
Percent of total trips targeting salmon						
1983-89	26%	9%	45%	29%	43%	6%
1993	24%	10%	14%	16%	N.a.[1]	N.a.
Percent of total harvest consisting of salmon						
1983-89	5%	3%	16%	29%	17%	6%
1993	N.a.	2%	2%	9%	N.a.	N.a.

[1]N.a. = not available.

Table 4-5
Average annual 1983-89 expenditures for marine recreational fishing on the Pacific coast.

Area and status	Shore	Charter boat	Private boat	Subtotal	Equipment	Total
S. CA resident	38,868	94,636	103,762	237,267	131,399	368,667
S. CA nonresident	8,865	12,139	9,536	30,541		30,541
S. CA total	47,733	106,775	113,298	267,808	131,399	399,208
N. CA resident					83,675	
N. CA nonresident						
N. CA total	41,166	19,612	56,654	117,432	83,675	201,108
OR resident				33,556	37,612	71,169
OR nonresident				5,550		5,550
OR total				39,106	37,612	76,719
WA resident				55,244	109,811	165,055
WA nonresident				6,470		6,470
WA total				61,714	109,811	171,525
Pac. coast resident					362,499	
Pac. coast nonresident						
Pac. coast total				486,062	362,499	848,560

West Coast Spotlight Article

The U.S. Pacific Tuna Industry

Because of its size and scope relative to output in other U.S. fisheries, and because canned tuna consistently ranks highest in U.S. per capita consumption, the U.S. tuna industry is of national importance in terms of fisheries production, fisheries policy and management, international trade, and foreign relations. It presents an interesting case study in fisheries management as the history of the industry traces out many of the characteristics of an open-access fishery. The industry has had a dynamic history and in recent years has undergone some significant changes mainly in response to: 1) unprecedented growth in international production and trade in raw-frozen and canned tuna, 2) conditions of access to distant water fishing grounds, and 3) domestic marine mammal policies.

While other U.S. tuna operations, such as the production and marketing of fresh tuna, have become increasingly important, they are still relatively minor and are not covered in this report. The material presented in this section has been drawn from annual U.S. tuna industry reviews (Herrick and Koplin, 1986, 1987; Parks et al., 1990) and U.S. tuna industry investigations by the U.S. International Trade Commission (USITC, 1990, 1992).

Harvesting Sector

Market Overview

U.S. tuna harvests and harvests by foreign sources determine the supply of raw tuna available to U.S. processors. Factors that directly affect both domestic and foreign tuna harvests include the condition of global tuna stocks, quantity and quality of fishing effort, and exogenous influences such as weather. The condition of global tuna stocks is largely decided by biological and environmental factors beyond the sway of market forces. Fishing effort is influenced to a great degree by markets for both raw and canned tuna, the primary market force being price. Also, the supply of imported raw tuna is strongly affected by competition in global raw-tuna markets.

Ex-vessel demand for raw tuna is determined mainly by the raw material requirements of U.S. canned tuna processors, which in turn are directly affected by conditions in the domestic market for canned tuna. U.S. processors rely foremost on a steady supply of domestically caught raw tuna, supplemented with imports to meet total raw tuna requirements.

Tropical Tuna Production

The harvesting sector of the U.S. tuna industry is dominated by large purse seiners that average greater than 1,000 tons hold capacity. Approximately 97% of the total U.S. tuna harvest is landed by the purse seine fleet. U.S. purse seiners harvest tropical tuna species (primarily skipjack and yellowfin tuna) which are canned as light meat tuna. Skipjack and yellowfin tuna harvests come from stocks that are most abundant along the Pacific coasts of Central and South America and among the island nations of the western tropical Pacific (WTP).

Between 1984 and 1993, the size of the U.S. tropical tuna purse seine fleet declined substantially (Table 1). The initial decline represented a continued response to conditions that developed in the industry during the late 1970's. Before then, the processing and harvesting sectors of the U.S. tuna industry were highly integrated. Processors became partners in vessel ownerships and entered into other forms of long-term contractual arrangements with independently owned vessels to assure steady supplies of tuna. By the late 1970's however, many foreign countries had begun to develop their own large-scale purse seine fleets, which led to a substantial increase in the supply of raw tuna available to U.S. processors. To take advantage of this new supply of low-cost tuna and become more competitive with aggressive foreign processors, U.S. processors began divesting them-

selves of interests in U.S. vessels. Without processor backing, many vessels had to leave the fishery.

Adding to their difficulties, U.S. tuna vessels were increasingly being denied access to tuna resources within the exclusive economic zones (EEZ's) of nations bordering the eastern tropical Pacific (ETP). Also at this time, an unusually strong El Niño event led to reduced availability of tuna resources in the ETP. This combination of events, plus potentially more abundant tropical tuna resources in the WTP as well as a shift of the U.S. processing facilities to the WTP, contributed to a major shift of U.S. purse-seine operations from the ETP to the WTP.

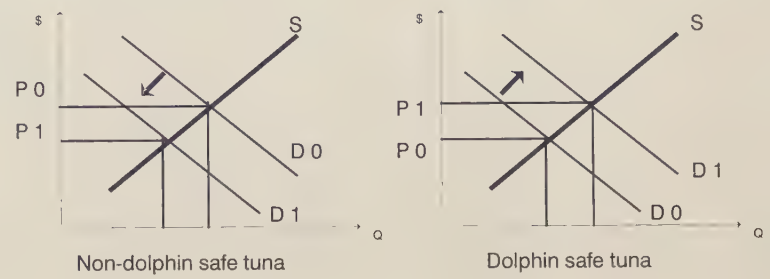
The move to the WTP required major technological changes to vessels that were originally designed to fish in the ETP, a sizable capital investment which made the move economically infeasible for many vessels. Many of the purse seiners that did not adapt either left the fishery or were sold to foreign-flag enterprises for use in the same tuna fisheries. This further contributed to the supply of foreign-caught tuna.

By 1987, the number of active U.S. tropical tuna vessels had stabilized and remained stable through 1989 (Table 1). During that period, the number of vessels operating in the ETP and WTP was fairly evenly split. Following the El Niño, fishing conditions in the ETP improved and a number of vessels returned from the WTP or reentered the fishery. U.S. operations in the WTP continued, enhanced by a combination of improved access to tuna resources afforded by the South Pacific Tuna Treaty (35 U.S. purse seiners were licensed to fish under the Treaty in 1989; 44 were licensed in 1993) and by expanding markets for raw tuna, particularly in Southeast Asia.

Table 1
U.S. cannery receipts[1] of domestically caught skipjack and yellowfin tuna (light meat tuna species), 1984-93.

Year	Landings[2] in millions of pounds		Revenues in millions of dollars (1987)		Days fished (thousands)	Number[3] of vessels	Number[4] of employees
	Skipjack	Yellowfin	Skipjack	Yellowfin			
1984	292.0	190.2	$121.8	$102.5	18.4	111	1,998
1985	168.0	245.9	55.4	106.8	16.2	94	1,692
1986	181.2	266.1	57.6	102.0	14.0	88	1,224
1987	174.6	327.6	62.5	146.1	15.6	76	1,368
1988	252.9	218.4	118.9	115.0	16.1	73	1,314
1989	206.1	236.1	76.6	104.8	15.1	75	1,350
1990	191.0	187.1	66.8	81.1	7.6	66	1,188
1991	257.2	76.2	83.5	27.6	8.0	61	1,098
1992	326.4	95.8	91.6	30.3	9.5	58	1,044
1993	312.5	95.5	93.5	32.3	10.9	55	990

[1]Cannery receipts are tuna delivered to U.S. processors. Excluded from cannery receipts are U.S.-caught tuna destined for export or for the fresh tuna market.
[2]May include some bigeye, blackfin, and bluefin tuna.
[3]Vessels making at least one trip during the year.
[4]Based on average size purse-seine crew of 18.



Tuna-dolphin issue: canned tuna products were differentiated between those tuna that were harvested without setting on dolphins and those that did. Changes in consumer preferences for "dolphin-safe" tuna shifted the demand outward for tuna harvested that way, increasing the equilibrium price and quantity.

Landings and Revenue

Although the reduction in U.S. purse seine fleet capacity was largely responsible for an overall decline in cannery deliveries during the 1984-93 period, the annual patterns in fleet numbers and domestic cannery deliveries do not exactly coincide (Table 1). The total real ex-vessel value of U.S. tropical tuna cannery deliveries ranged from a high of $234 million in 1988 to a low of $111 million in 1991, reaching $126 million in 1993.

The "Dolphin-safe" Policy

In the ETP, yellowfin tuna are frequently found in large schools that associate with various species of dolphins. Purse seine fishermen take advantage of this association by setting their nets around dolphin schools. This procedure, known as "dolphin fishing," usually catches the relatively large, highly valued yellowfin tuna that are located below the dolphins. In the process of retrieving the net, dolphins sometimes become inadvertently entangled and drown (Perrin, 1969; Green et al., 1971). To alleviate consumer fears that dolphins were being imperiled, U.S. canned

Table 2
U.S. cannery receipts of domestically caught albacore (white meat tuna), 1984-93.

Year	Landings (million pounds)	Revenues (1987 million dollars)	Days fished	Number of vessels	Number of employees[1]
1984	27.8	19.1	55,203	1,400	4,200
1985	13.7	7.9	27,417	950	2,850
1986	7.1	4.0	23,402	700	2,100
1987	5.7	4.2	17,165	800	2,400
1988	15.3	12.4	19,158	400	1,200
1989	9.8	8.1	17,705	400	1,200
1990	13.9	10.8	15,060	450	1,350
1991	12.9	8.4	17,950	200	900
1992	13.7	12.0	22,456	600	1,800
1993	15.0	12.2	31,094	650	1,950

[1]Based on an average troller crew of three.

tuna processors instituted a "dolphin-safe" policy in April, 1990 (USITC, 1992).

U.S. processors refused to buy tuna from suppliers who could not certify that the tuna was "dolphin-safe." Under the International Dolphin Conservation Act[1], the "dolphin-safe" policy, indicating that tuna processed into canned tuna were harvested using methods not harmful to dolphins, became a statutory requirement. The Act essentially precludes purchases of any tuna caught in the course of dolphin fishing in the ETP, since some incidental dolphin mortality is unavoidable in this method of fishing. As a result of the dolphin-safe policy, the U.S. fleet virtually abandoned the ETP, relocating to the WTP where dolphins and tunas do not have the same association. Those vessels that could not make this transition either remained in the ETP and fished using methods that did not endanger dolphins or left the fishery.

The significant increase in skipjack receipts and decline in yellowfin receipts beginning in 1991 reflects the shift of the U.S. fleet from the ETP to the WTP in response to the dolphin-safe policy. Before implementation of the policy, U.S. purse seiners operated mainly in offshore waters of the ETP where large yellowfin dominated harvests. In contrast, skipjack dominate harvests in the WTP. Because ex-vessel prices for skipjack and yellowfin are differentiated by size and species (large yellowfin [>20 pounds] command the highest price), the shift to the WTP represented a change from a low-volume, high-value operation to a high-volume but low-value operation.

[1]The Dolphin Protection Consumer Information Act (PL 101-627) of 1990 contained a labeling standard for tuna voluntarily labeled as "dolphin safe." Non-dolphin safe tuna was still allowed in the U.S. market. Under the International Dolphin Conservation Act of 1992, a statutory dolphin-safe U.S. market became law.

Extended Jurisdiction

Before 1992, tuna resources were excluded from U.S. jurisdiction under its 200-n.mi. EEZ, and the U.S. did not recognize other nations' claims to jurisdiction over tuna within their EEZ's. However, amendments to the Magnuson Fishery Conservation and Management Act (MFCMA), which became effective in January 1992, reversed those policies. Under the new conditions, renewal and establishment of agreements such as the South Pacific Tuna Treaty of 1987, which provides U.S. tuna harvesters with expanded access to tuna resources within foreign zones, have become extremely important.

Production of Albacore Tuna

The remaining U.S. tuna cannery harvest consists mainly of albacore tuna, a temperate tuna species, caught using troll vessels and processed exclusively as white-meat tuna. (Albacore is the only tuna species that can be canned as white-meat tuna in the United States.) U.S. albacore trollers are relatively small, with an average hold capacity of 20-25 tons, although there is a recently developed U.S. fleet of distant-water trollers with carrying capacities averaging about 70 tons. About 600 small trollers participate annually in the north Pacific albacore fishery, usually within 300 miles of the California, Oregon, and Washington coasts. Unlike purse seiners, these vessels are easily adapted for use in other fisheries, such as salmon or crab. Consequently, most Pacific coast trollers will alternate between the albacore, salmon, and crab fisheries during the course of the year, depending upon the relative availability and prices of these species. This accounts for the great variability in the number of trollers participating in the North Pacific albacore fishery on an annual basis (Table 2). The larger, distant-water U.S. trollers first appeared with the development of the U.S. south Pacific albacore troll fishery in 1986. Since that time, about 40 U.S. trollers have consistently participated in the fishery. Because of the technology employed and

the nature of the albacore itself, the U.S. albacore harvesting sector is completely "dolphin-safe."

There was a tremendous decrease in albacore cannery deliveries by U.S. vessels from 1984 to 1987 (Table 2). In 1988, albacore deliveries increased sharply then fluctuated through 1990, with a similar pattern for ex-vessel value. Between 1991 and 1993, albacore deliveries and ex-vessel values increased steadily reaching 15 million pounds, with a real value of $12.2 million in 1993. The recent increase in the value and volume of U.S. albacore deliveries can be largely credited to the U.N. prohibition on the use of large-scale driftnets on the high seas which went into effect 31 December1992 (USITC, 1992). The driftnet prohibition was followed by a sharp drop in the global supply of albacore and a corresponding increase in raw albacore prices in the international market. Higher prices are likely to persist in the near term since the supply shortfall cannot be readily made up with currently available methods (e.g., trollers) as with the highly efficient driftnets. It is likely that the higher prices, combined with an anticipated increase in albacore stocks as a result of the driftnet ban, will attract additional U.S. trollers into the North and South Pacific fisheries.

Processing Sector

Market Overview

The overall supply of canned tuna in the U.S. market is determined by the level of domestic processing and the volume of imports. The supply of U.S.-processed canned tuna is influenced by U.S. canned tuna prices, raw material availability, and production costs. The quantity of U.S. canned tuna imports is influenced by the same factors that affect domestic supply as well as conditions in alternative markets.

The demand for canned tuna in the U.S. is mainly determined by population, the price of canned tuna relative to competing products, real disposable income, and consumer preferences. A notable shift in preferences was the change from tuna packed in oil to tuna packed in water during the 1980's as U.S. consumers became increasingly more health and nutrition conscious. Also, demand has been particularly sensitive to consumer concerns over dolphin mortality in tuna fishing as discussed above. Most canned tuna is distributed through retail outlets, and price competition with other foodstuffs, particularly ground beef, chicken, pork, and canned salmon, is strong.

Canned Tuna Production

U.S. tuna processors produce canned tuna for human consumption and byproducts, primarily tuna-based pet foods. Canned tuna for human consumption is available in an assortment of packs distinguished by type of meat (white or light), packing medium (water or oil), and form (chunk, solid, flake, and grated). Light meat accounts for 75-80% of annual domestic canned tuna consumption; albacore or white meat makes up the balance. Chunk, light meat in water is the most popular light meat pack, although there still appears to be a core demand for oil-packed canned light-meat tuna. Albacore is packed almost exclusively in water in solid form. Canned tuna is marketed in both retail size and institutional size containers.

U.S. processors use either domestic or imported raw (fresh, chilled, or frozen) tuna as raw material in the production of canned tuna, with near perfect substitutability. During 1984-93, domestically caught tuna made up about 45-55% of processors' raw tuna requirements. Yellowfin and skipjack tuna accounted for 95-99% of domestically caught cannery receipts during the period; foreign caught cannery receipts consisted almost entirely of yellowfin and skipjack tuna and albacore.

Tuna-Dolphin Issues

During the 1984-93 period, there were several events that had a significant impact on the way raw tuna was obtained by U.S. processors. First, there was more rigorous enforcement of provisions in the Marine Mammal Protection Act (MMPA) that enacted primary[2] and secondary import embargoes[3] on imported tuna harvested using means that result in an incidental kill of dolphins exceeding U.S. standards. Primary embargoes were placed on direct imports from harvesting nations whose harvests did not meet U.S. dolphin mortality standards. Secondary embargoes were placed on intermediary nations in cases where there was an attempt to circumvent a primary embargo through trans shipment.

[2] 16 U.S.C. 1371(a)(2)(B)(ii)(II)

[3] 16 U.S.C. 1371(a)(2)(C)

Table 3
U.S. processing of canned light meat tuna, continental U.S., Hawaii, American Samoa, and Puerto Rico, 1984-93.

Year	No. of Plants	Million pounds	Value (1987 million dollars)	No. of employees
1984	11	477.5	676.5	11,026
1985	8	413.1	583.6	11,293
1986	8	479.5	578.6	12,198
1987	8	511.1	704.1	11,546
1988	9	467.0	618.9	12,145
1989	9	549.0	656.6	12,435
1990	9	448.6	508.0	10,672
1991	7	470.8	506.2	10,398
1992	7	464.9	432.0	9,366
1993	7	468.8	429.6	9,207

Table 4
U.S. processing of canned white meat tuna, continental U.S., Hawaii, American Samoa and Puerto Rico, 1984-93.

Year	No. of Plants	Million pounds	Value (1987 million dollars)	No. of employees
1984	16	136.7	281.0	11,099
1985	14	131.9	285.9	11,368
1986	13	157.3	331.1	12,267
1987	12	139.9	312.4	11,602
1988	15	131.2	305.3	12,189
1989	13	137.3	318.3	12,440
1990	13	131.9	288.9	10,736
1991	16	121.6	238.5	10,493
1992	15	144.1	301.1	9,444
1993	12	150.0	302.4	9,293

Second, the processors' own dolphin-safe policy curtailed imports from nations whose harvests were made using methods harmful to dolphins. These two events drastically reduced yellowfin tuna from the ETP as a source of raw material for U.S. processors. As discussed, the International Dolphin Conservation Act (IDCA) of 1992 made processors' dolphin-safe policy into U.S. law. To make up for the yellowfin shortfall, U.S. processors began using more skipjack tuna, primarily from U.S. harvests in the WTP, and imported raw tuna from a wider variety of sources.

Development of Loining Technology

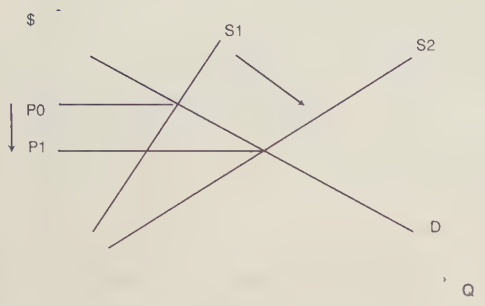
A third consideration affecting processors' use of raw material inputs was the development of tuna loining technology which to some extent shifted raw material inputs from whole tuna to precooked, frozen tuna loins. Loins are free of waste material (bone, viscera, etc.) and are that portion of the whole fish that is converted to canned product. The use of loins represents a significant reduction in labor costs, as at least 60% of the total labor cost in traditional tuna processing plants is incurred from their production of loins. In addition to reduced production costs, there can be a substantial savings in freight costs from using loins. Depending on the size and species of tuna, the loin can weigh less than half the amount of the whole fish since waste material is not transported with loins.

Industry Restructuring

Up until the 1980's, southern California was the processing hub for the U.S. tuna industry. However, it was at this time that a number of adversities beset U.S. processors, including declining revenues, rising production costs, and increased competition from canned imports. To overcome these difficulties, U.S. processors shifted the bulk of their operations to offshore sites in American Samoa and Puerto Rico to take advantage of latent production capacity, greater resource availability, lower labor costs, significant tax benefits, and savings realized from consolidating operations. By 1985, only one major processing plant was still operating in California, while seven plants operated in Puerto Rico and America Samoa, and six small plants (less than 1% of total U.S. canned tuna production) produced only white meat tuna in Oregon and Washington. By 1993, there were two large-scale plants in California, three in Puerto Rico, and two in America Samoa processing both light and white meat tuna (Tables 3, 4). Also, during this time, two of the three major U.S. tuna processing operations had been acquired by Thai and Indonesian interests.

Plants and Employment

Employment figures and the number of plants in operation at all U.S. cannery locations for the period 1984-93 are presented in Tables 3 and 4. The most meaningful trends in cannery employment and plant operations can be derived from employment figures for light-meat processing presented in Table 3, because the large-



U.S. tuna canneries have faced increasing costs due to higher relative wages, resulting in a shift in production to lower-wage countries.

Table 5
U.S. processing of canned white and light meat tuna, continental U.S., Hawaii, American Samoa, and Puerto Rico, 1984-93.

Year	No. of Plants	Total production (million pounds)	Total value (1987 million dollars)	No. of employees	Percent light meat	Percent white meat
1984	16	614.2	957.5	11,099	78	22
1985	14	545.0	869.5	11,368	76	24
1986	13	636.8	909.7	12,267	75	25
1987	12	651.0	1,016.5	11,602	79	21
1988	15	598.2	924.2	12,189	78	22
1989	13	686.3	974.9	12,440	80	20
1990	13	580.5	796.8	10,736	77	23
1991	16	592.4	744.7	10,493	79	21
1992	15	609.0	733.0	9,444	76	24
1993	12	618.8	732.0	9,293	76	24

scale plants and production volumes presented therein account for the bulk of employment in the U.S. tuna processing sector. Information from Tables 3 and 4 is combined in Table 5 to provide a clearer picture of overall employment and plant operations during the 1984-93 period.

As shown in Table 5, cannery employment declined between 1984 and 1993, but not continuously. During 1984-86, employment rose while the number of large-scale plants decreased, reflecting the consolidation of U.S. processing operations offshore and increased use of lower-cost labor. After a decrease in 1987, cannery employment rose in 1988-89 mainly due to increased production at offshore facilities. During 1990-93, there was a steady decline in cannery employment as loin-based processing expanded (a California plant specifically designed for loin processing opened in 1990), and two plants shut down in Puerto Rico. The Puerto Rico plant closures followed enactment of the dolphin-safe policy which, due to Puerto Rico's dependency on yellowfin tuna from the ETP, was the cannery location most affected by the policy and MMPA import embargoes. With the overall increase in canned tuna production during 1984-93, accompanied by a decline in the number of active plants and total cannery employment, canned tuna productivity improved both in terms of output per plant and output per worker.

Trade Sector

Raw-Frozen Tuna

Following the closure of U.S.-mainland processing plants in the 1980's there was a substantial increase in frozen tuna exports by the U.S. tuna fleet. Most of the exports consisted of tropical tuna caught by U.S. purse seiners in the WTP. For the most part, these catches were transshipped from sites such as Tinian and Guam to Asian processors; Indonesia and Thailand were the primary destinations. Licensing arrangements between Thai and U.S. processors to ship canned tuna to the U.S. market, and the purchase of U.S. canneries by Indonesian and Thai interests, led to increased raw material requirements at plants in these areas. These needs have been largely met by exports from foreign fleets.

The rise in the value of exports in 1990 (Table 6) is mainly attributable to increased exports of large yellowfin tuna, as the U.S. processors' dolphin-safe policy came into effect and U.S. harvesters diverted their ETP yellowfin catches to foreign canners. Exports of skipjack tuna have increased since 1991 while yellowfin tuna exports have decreased, reflecting the increase in U.S. fishing activity in the WTP.

In comparison, U.S. imports of frozen tuna dwarf exports. Imports frequently make up more than half the total annual U.S. cannery supply of frozen tuna. Albacore usually dominates U.S. imports of frozen tuna in both quantity and value; skipjack and yellowfin tuna follow (Table 6). The dominance of imports in U.S. foreign trade in frozen tuna has led to the imbalances shown in Table 7.

Canned Tuna

U.S. exports of canned tuna are trifling compared with imports (Table 6). This is primarily due to the lack of U.S. competitiveness in the major foreign canned tuna markets, particularly Japan and the European Community. Factors that make it difficult for U.S. processors to penetrate foreign markets include: relatively high duties in foreign markets, high transportation costs from relatively remote production locations (American Samoa and Puerto Rico), noncompatible product and quality specifications that would increase production costs, competition from low-cost Asian product, and the presence of large, well-established tuna industries in France, Spain, and Italy.

The tremendous increase in U.S. imports of canned tuna which began in the early 1980's (Table 6) was mainly due to a shift in consumer dietary preferences from tuna packed in oil to tuna packed in water. Combined with a disparate tariff on tuna canned in water, this created an unprecedented opportunity for canned imports (virtually all light meat in water) to inundate the domestic market. Thailand has been the main source of canned imports followed by the Philippines and Taiwan. The value of canned imports peaked in 1989 following the ownership changes in the industry, then fell off sharply in 1990 as the U.S. market became saturated (Table 6). In 1991, there was a significant rebound in the value of canned imports as volumes reached a record high. Since then there has been a drop in value that has been attributed to production problems in Southeast Asia and a shift in their canned tuna exports to European markets. As in the case of frozen tuna, there is a significant foreign trade imbalance in canned tuna (Table 7).

Table 6
Exports and imports of frozen and canned tuna, 1984-93 (in 1987 million dollars).[1]

Item	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Frozen tuna exports										
Albacore						0.1	0.4	0.1	0.6	0.6
Skipjack						0.6	0.5	0.3	0.3	0.5
Yellowfin						0.1	1.1	1.6	0.6	0.4
Unspecified						2.4	4.3	1.4	1.1	0.6
Total						3.2	6.4	3.4	2.6	2.1
Frozen tuna imports										
Albacore	148.6	141.1	157.0	171.9	194.8	179.1	126.1	100.1	170.4	169.1
Skipjack	96.4	69.3	83.4	72.6	93.6	84.0	55.7	26.4	34.8	31.8
Yellowfin	30.1	45.1	48.4	63.3	43.8	60.4	22.8	25.7	9.2	13.0
Total	275.1	255.5	288.8	307.8	332.2	323.4	204.7	152.2	214.4	213.8
Canned tuna exports										
All types[2]						8.5	11.7	13.3	10.7	8.5
Canned tuna imports										
In oil										
Unspecified	0.5	0.6	0.7	1.0	0.7	0.8	1.0	0.8	0.7	0.6
In water										
White	17.9	16.5	15.9	26.8	49.9	57.5	49.1	38.7	26.5	12.6
Light	165.2	204.4	219.4	160.3	221.6	261.3	193.6	247.6	219.3	156.2
Total	183.6	221.6	236.0	188.1	272.1	319.6	243.7	287.0	246.5	169.4

[1]Excludes frozen tuna exports from canneries in American Samoa.
[2]Includes exports under the tariff code "tuna nspf prepared/preserved," which contains loins (nspf=unspecified).

Table 7
Frozen and canned tuna trade balances, 1989-93 (in 1987 million dollars).

Year	1989	1990	1991	1992	1993
Frozen tuna trade balance	-320.2	-198.2	-148.8	-211.8	-211.7
Canned tuna trade balance	-311.2	-232.1	-273.7	-235.8	-160.9

Conclusions

This description of the U.S. Pacific tuna industry exemplifies the way in which economic forces help shape the development and evolution of a fishery. For example, in just the 10-year period encompassed in this spotlight article, the fleets in the yellowfin and skipjack tuna and albacore fisheries have significantly declined and have decreased the number of fishing days in response to reduced financial support from processors, declining stock levels, and increased competition from foreign harvesters; tuna vessels have shifted their operations between the ETP and WTP in response to changing market and resource availability conditions; and they have changed harvest methods and target species to accommodate the MMPA and other Acts enacted out of consumer concern for dolphin bycatch. The tuna processing industry has been similarly shaped, moving operations to overseas sites to take advantage of lower labor costs, tax benefits, and increased resource availability; technological changes in processing have lowered labor costs significantly; MMPA embargoes and dolphin-safe policies altered the sources and species of tuna acceptable for processing; and domestic processors were negatively impacted by the shift in consumer preferences and, hence, demand for tuna packed in water rather than in oil. In all cases, harvesters and processors have acted rationally, and predictably, to the economic, regulatory, and biological forces at work.

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Chapter 5

The Western Pacific Regional Report

The Commercial Harvesting Sector

Introduction

U.S. domestic fisheries in the western Pacific Ocean are conducted in three geographical areas: Hawaii's EEZ and the surrounding North Pacific, the EEZ's of American Samoa, Guam, and the Northern Mariana Islands, and the South Pacific distant-water tuna purse seine and albacore troll fisheries. This article concentrates on Hawaii fisheries with some reference to the other U.S. island fisheries. The purse seine and albacore fisheries are not covered in this report, but are the subject of the national spotlight issue.

Hawaii Fisheries

Hawaii's commercial fisheries have experienced a dramatic period of rapid growth and structural change over the past 15 years (Pooley, 1994). During this period the largest domestic fishery, the aku boat fishery (pole-and-line skipjack tuna fishery), collapsed due to the closure of the Honolulu tuna cannery. During the same time, the Northwestern Hawaiian Islands (NWHI) spiny and slipper lobster and bottomfish (snappers, groupers, and jacks) fisheries were developed, and the pelagic longline fishery (tunas, tuna-like fishes, billfish, and swordfish) exploded in activity. Total domestic commercial landings rose from 12 million pounds, worth $20 million (in real dollars), in 1980 to 36 million pounds, worth $59 million, in 1993 (Fig. 5-1). This represents a tripling of landings and real ex-vessel revenue in slightly more than a decade. Table 5-1 summarizes Hawaii's domestic commercial fishery in 1993.

Hawaii's domestic commercial fisheries are a mixture of mid-scale "distant-water" and small-scale fisheries which operate close to the main Hawaiian Islands (MHI). These latter fisheries are primarily handline and trolling but also include trap, spear, and various types of scoop-net fisheries. About 200 vessels crewed by about 1,250 peo-

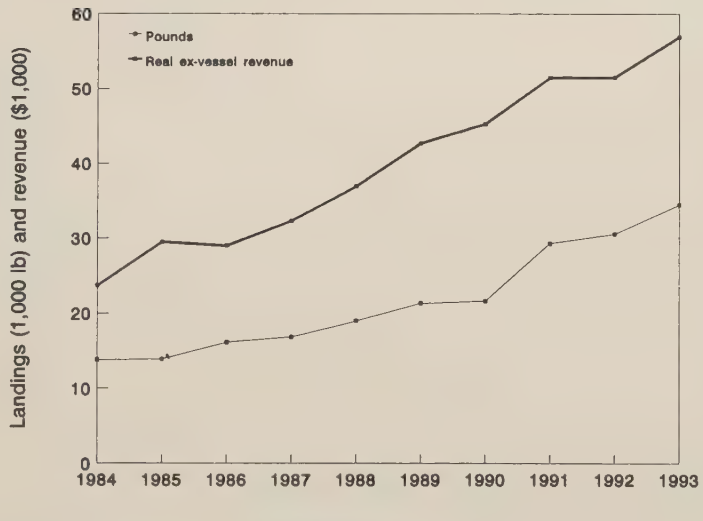


Figure 5-1
Hawaii commercial fishery landings and real ex-vessel revenues.

Table 5-1
Hawaii domestic commercial landings, 1993[1].

Fleet	Landings: Amount (1,000 lb)	Landings: Nominal value ($1,000)
Longline[2]	26,500	57,000
Troll-hand pelagics[3]	4,800	7,800
Aku boat[3]	2,100	2,400
MHI[4] bottomfish[3]	500	1,500
NWHI[5] bottomfish[2]	400	1,200
NWHI Lobster[2,6]		
Other[3]	1,400	2,500
Total	35,700	72,400

[1]NMFS SWFSC Honolulu Laboratory estimates.
[2]National Marine Fisheries Service longline and lobster logbook estimates and NWHI shoreside monitoring of bottomfish landings.
[3]Hawaii Division of Aquatic Resources commercial catch reports for troll-handline, aku boat, MHI bottomfish, and other.
[4]MHI = Main Hawaiian Islands.
[5]NWHI = Northwestern Hawaiian Islands.
[6]Closed in 1993; 1992 landings of 466,000 pounds ($2.1 million).

ple participate in the larger commercial fisheries, while an additional 2,500 people have commercial fishing licenses in the small-scale fishery[1]. Figures 5-2 and 5-3 display commercial fishing vessel participation for the three Federally regulated fisheries (longline and NWHI bottomfish and lobster), and the associated small-scale fisheries (troll-handline for pelagics and bottomfish). The figures show the dramatic increase in the longline fishery in the late 1980's as well as the mid-1980's peak in the development of the NWHI fisheries. Participation in small-scale fisheries has not been measured on an annual basis; the figures represent an average of full-time participation over the period (the same is true for crew employment and fishing effort). However, actual participation varies substantially, depending on overall economic conditions, the cost of fuel, fish availability (catch per unit effort), and fish prices.

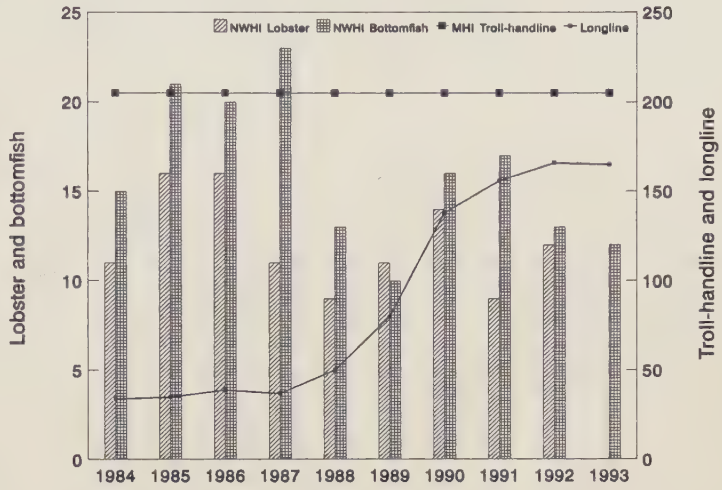


Figure 5-2
Number of vessels participating in Hawaii commercial fisheries (NMFS estimates).

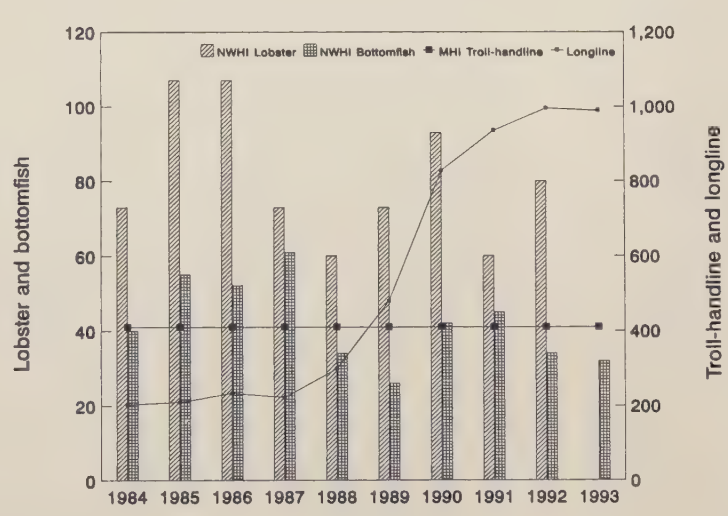


Figure 5-3
Number of full-time crew members participating in Hawaii commercial fisheries (NMFS estimates).

Other Western Pacific Fisheries

The domestic commercial fisheries in American Samoa, Guam, and the Northern Mariana Islands are much smaller, but they are important locations for transhipment and processing for the U.S. distant-water purse seine fishery as well as for foreign purse seine and longline fisheries (Table 5-2).

American Samoa has two tuna canneries that receive substantial quantities of U.S. distant-water purse seine landings and U.S. albacore troller landings, both destined for the canneries, and foreign tuna longline landings, some of which are reexported to Japan. Guam and the Northern Mariana Islands have both served as tuna transhipment centers for U.S. as well as Japanese and Taiwanese tuna fleets. Honolulu serves as a major center for resupply for Japanese, Taiwanese, and South Korean tuna longline vessels. While not commercial fishing per se (foreign vessels are not allowed to off-load in U.S. ports, excluding American

Table 5-2
Domestic commercial fishery landings and revenue in American Samoa, Guam and the Northern Mariana Islands, 1993[1].

Area	Landings (1,000 lb)	Ex-vessel value ($1,000)
American Samoa	108	275
Guam	373	778
Northern Mariana Islands	374	613

[1]NMFS WPACFIN (Western Pacific Fishery Information Network) data compiled from island fishery agencies.

[1]Most of these 2,500 commercial fishing license holders are part-time fishermen. We estimate full-time commercial participation in these fisheries at 200 vessels with about 400 crew members.

Samoa, Guam, and the Northern Mariana Islands), resupply is an important source of income in the marine sector for these three island economies as well as Hawaii.[2]

Federally Regulated Fisheries

The domestic U.S. fisheries in this area are regulated by the Western Pacific Fishery Management Council (WPFMC) whose jurisdiction includes American Samoa, Guam, Hawaii, and the Northern Mariana Islands. The Federally managed domestic fisheries[3] (NWHI bottomfish and lobster fisheries and the Hawaii longline fishery) are controlled through limited entry arrangements (see this region's spotlight article) and various biological measures as well as technological measures to protect the endangered Hawaiian monk seal and a variety of sea turtles. Potential fishery management issues include: making a transition from nontransferable permits in the NWHI bottomfish limited entry fishery, finding an alternative to "boom-bust" quota seasonal management in the NWHI lobster fishery, controlling the growth of the pelagic longline limited entry fishery, and addressing the issue of bycatch in the longline fishery (particularly sea turtles but also sharks and the capture and sale of billfish). Although Hawaii's large-scale commercial fisheries operate out of a few ports (primarily those in Honolulu), the costs and diseconomies of regulation and enforcement necessitate a regulatory system that is relatively simple in design. Limited entry has been the preferred system in the past, but alternative management forms such as transferable effort rules and corporate or cooperative management are now being explored for these fisheries instead of enforcement-intensive ITQ's.

The NWHI fisheries are "distant-water" fisheries in the sense that vessels must travel at least 500 miles from Honolulu to reach the fishing grounds. Similarly, many of the productive longline fishing grounds are outside the U.S. 200-mile EEZ around Hawaii. The vessels in these fisheries are relatively small (<100 feet in length). The NWHI bottomfish fishery is a deep-sea handline fishery, while the lobster fishery is a trap fishery. Participation in both the NWHI fisheries is low, with only 15 permitted vessels in the lobster fishery (with participation annually at 5-10 vessels) and only 35 permitted vessels in the bottomfish fishery. The NWHI lobster fishery was closed in 1993, experienced a truncated season in 1994, and was open under an experimental fishing permit for only one vessel in 1995. Vessels in the longline fishery average 70 feet in length overall. This fishery has larger participation, with 166 limited entry permits and as many as 125 vessels active in recent years.

Fisheries in Hawaiian Waters

Fleets in the MHI are primarily comprised of small fishing vessels (<50 feet). The MHI pelagic fishery targeting tunas and billfish includes the few remaining aku boats, a large fleet of several thousand commercial and sportfishing charter trollers, and bottom handliners. The MHI bottomfish fishery uses bottom handlines as well as traps. Other fisheries include a trap fishery for lobster and shrimp and net fisheries for near-shore pelagics, as well as a number of dive fisheries for reef fish. While the landings from the MHI troll and handline vessels are characterized here as commercial, the distinction between commercial, recreational, and subsistence fishing is difficult in Hawaii, as discussed later.

Economic Research in the NWHI Lobster Fishery

A thorough cost-earnings study indicated that the NWHI lobster fleet could be categorized into three size-ownership components on economic performance grounds. The larger vessels were estimated to be losing money largely due to high fixed costs; so were the medium-sized hired captain vessels due primarily to low productivity. However the owner-operator medium-sized vessels were estimated as profitable, due to both lower variable costs and higher productivity (Clarke and Pooley, 1988). Since 1986, when the economic data were collected, the largest vessels

[2]Iversen and Lucas (1992) estimated that the number of port calls by foreign longline fishing vessels into Honolulu Harbor averaged 2,500 visits annually in 1986-88, generating $32 million annually in direct expenditures.

[3]There are also WPFMC fishery management plans for the Hawaii precious coral fishery and the Hawaii seamount groundfish fishery, but these fisheries have been closed for many years due to overharvesting by foreign vessels prior to the implementation of the MFCMA.

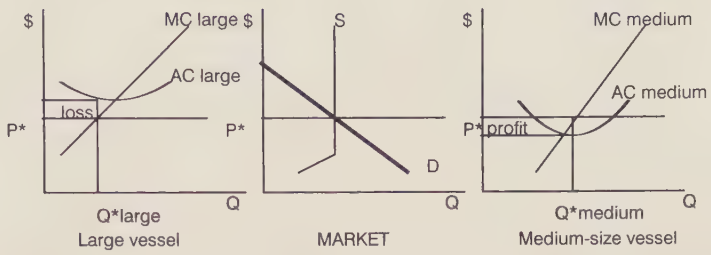
have reduced their participation in the fishery, as might be expected.[4] The medium-sized hired captain vessels have since undergone a number of changes, and those that remain in the fishery now operate more like owner-operator vessels.

A detailed bioeconomic model of the fishery was prepared using information from the late 1980's, prior to the current management regime (Clarke et al., 1992). This analysis indicated that the difference between maximum sustainable yield (MSY) and both maximum economic yield (MEY) and open-access equilibrium yield (OAY) was less than 12% in terms of landings (yield) but 42-45% in terms of fishing effort.[5] However, the bioeconomic model was based on a biological assessment that estimated MSY to be in the range of 1 million lobsters. A dramatic decrease in catch rates occurred in 1990, due to an oceanographic perturbation that affected recruitment to the lobster stocks, total lobster biomass, and the availability of spiny lobsters in particular (Polovina and Mitchum, 1992; Polovina et al., 1994). The reduced catch rates continued, resulting in the closure of the fishery in 1993, and a relatively small quota in 1994. Although MSY has not been "officially" revised, it appears that under the current environmental conditions the de facto MSY is 200,000-300,000 lobsters.

Thus, the situation in the NWHI lobster fishery was bleak. Furthermore, the management regime was economically inefficient with seasonal quotas and a "use-it-or-lose-it" rule on permits that promoted excess effort. For all but the smallest vessels (which might fish year-round at low levels of productivity if not for the seasonal quota) or those medium-sized vessels that could switch to the longline fishery when the lobster fishery was closed, the NWHI lobster fishery was no longer economically viable. While positive profits existed in the fishery's early years of development in the early 1980's, it appears that only the hope of improved conditions sustains participation in the fishery today. If the oceanographic conditions that suppressed biomass continue for many more years, the loss of an active market for Hawaiian lobsters will accentuate these problems.

[4]Except for participation forced by an every other year "use-it-or-lose-it" clause in the limited entry program.

[5]MEY indicates the most economically efficient level of production, and is usually at a lower level of fishing effort than MSY in a standard stock production model (see Chapter 2). OAY refers to the level of production in an open access fishery and is usually at a higher level of fishing effort than MSY.



Hawaii lobster fishery: managed by quotas (vertical supply). Larger vessels incur losses (p<average costs) while medium-size vessels make a profit (p>average costs).

Economic Research in the NWHI Bottomfish Fishery

The NWHI bottomfish fishery is divided into two regulatory zones: a more distant limited-entry zone and a closer open-access zone. Fifteen vessels have permits to operate in the limited-entry zone, while 20 are permitted to fish in the open-access zone. A recent study of this fishery suggested that the vessels in the limited-entry zone realized a small but positive economic return while those in the open-access zone realized substantial losses (Hamilton[6]). However, vessel operators in the open-access zone were found to have mixed motivations, with noncommercial fishing activities also important to them (e.g., recreational and charter fishing, funerals, and sight-seeing). The analysis indicated that the entire NWHI bottomfish fishery (i.e., eliminating the concept of "zones") could sustain 15 vessels on a full-time basis, as compared to 12 active vessels in 1993.

The regulatory impact analysis for the WPFMC's moratorium in the longline fishery estimated that the average longline fishing vessel realized an economic loss of $85,000 in 1991[7]. Not surprisingly, many longline vessel owners and captains also expressed distress in public meetings

[6]Hamilton, M. 1994. NWHI bottomfish fishery 1993 vessel activities: costs and economic returns. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Sci. Cent. Admin. Rep. H-94-lC.

[7]The RIR was constructed on sparse information. An important research initiative, the Pelagic Fisheries Research Project under the University of Hawaii and NOAA's Joint Institute for Marine and Atmospheric Research, has funded a comprehensive economic research project for Hawaii's pelagic fisheries. This will improve the status of economic information by the end of 1995. (Pooley, 1994c).

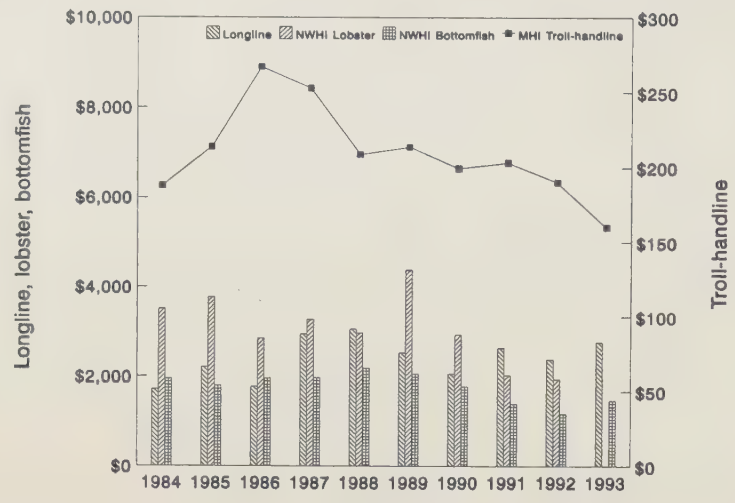


Figure 5-4
Hawaii commercial fisheries real daily revenue per vessel, by fishery.

and at the docks about the condition of the fishery as well as the regulatory climate. This was a period of substantial regulatory uncertainty in the longline fishery, coinciding with the period in which a number of vessel operators were still learning how to use monofilament gear effectively. Economic conditions appear to have stabilized in the past 2 years and are expected to improve as longline permits become transferable under the new limited entry regulations.

The results from these and other economic studies of Hawaii's commercial fisheries (Fig. 5-4) show trends in estimated real average annual ex-vessel revenue per vessel. Revenue in the small-scale fisheries varies with catch rates; these vary annually due to the changing near-shore availability of highly migratory species such as tunas and other pelagics. Even in the longline and Northwestern Hawaiian Islands fisheries where larger vessel sizes predominate, there are substantial "booms and busts" in returns to the fisheries. These features are the result of Hawaii's geographical and oceanographic isolation, the topology of its ocean environment, and the effects of evolving economic and regulatory regimes.

The Seafood Processing Sector

Since the Hawaii market is dominated by fresh product, seafood processing is limited. Primary product forms include fish cake and dried fish as well as various "specialty" packs. The NMFS Southwest Regional Office estimates that seafood processing in Hawaii was 9 million pounds in 1993, produced by 26 relatively small plants. Processed value was roughly $16 million, less than 25% of landed ex-vessel value. Employment was estimated at 250 people, but many of these may also be engaged in retail operations.

The Retail Market and Trade Sector

Hawaii's Seafood Markets

Domestic commercial landings provide about 27% of the Hawaii seafood market, with the balance supplemented by imports and shipments from mainland U.S. producers (Table 5-3). Hawaii's seafood market is primarily fresh product with bigeye and yellowfin tuna (known locally as ahi) directed toward sashimi (raw fish) at retail prices exceeding $20 per pound at New Year's. Many of the other pelagics landed, of which mahimahi (dolphin fish) and striped marlin are mainstays, are directed at restaurants, along with many of the bottomfish. Skipjack tuna is commonly sold for home consumption, either as fillets or in a prepared product called poki (marinated with vinegar, soy sauce, and spices). Most of the swordfish is "exported" to the U.S. east coast. Frozen lobster tail was initially exported to the U.S. mainland or overseas, but under the current quota regime an increased percentage of the lobster harvest is sold as a live product and remains in Hawaii for the upscale restaurant market.

Table 5-3
Supply and revenue of Hawaii seafood market channels, 1993[1].

Source of supply	Thousand pounds	Thousand dollars
Domestic commercial landings	35,700	72,400
+ Recreational landings	10,200	
= Hawaii domestic fishery landings	45,900	72,400
+ Foreign imports	22,000	40,600
+ U.S. mainland "imports"	34,300	62,400
– Export (foreign and U.S. mainland)	14,600	29,600
= Hawaii market (commercial only)	77,400	145,600
= Hawaii consumption (including recreational)	87,600	

[1]NMFS SWFSC Honolulu Laboratory estimates.

Table 5-4
Hawaii seafood imports, 1993[1].

Item	Pounds imported
Fresh/frozen fish	9,231,130
Fresh/frozen shellfish	6,918,257
Canned fish	181,555
Canned shellfish	45,741
Dried fish	38,270
Dried shellfish	43,643
Miscellaneous	264,433
Total (Market News)	16,723,029
Total (U.S. Customs)	22,000,000

[1]Data compiled from U.S. Food and Drug Administration samples by NMFS Southwest Region, Market News Division. NMFS Market News figures differ from U.S. Customs figures because invoices are not available for Market News recording on all imports. U.S. Customs figures do not provide species and product form details.

Figures 5-5 and 5-6 summarize ex-vessel, round-weight price trends for the major species. Swordfish prices show the shift from swordfish as a bycatch in the tuna longline fishery to a targeted species sold on the U.S. mainland. These prices also demonstrate the impact of Hawaii landings in that market. The dramatic increase in tuna prices may be inaccurate due to reporting problems, but it does represent the internationalization of the Hawaii tuna market, with ahi now sold throughout the U.S. mainland and Japan. Bottomfish prices, including the prized opakapaka (pink snapper), have shown little change over the period. The difference between spiny and slipper lobster prices indicates the difference in their market penetration.

While imports and exports are important to Hawaii's seafood markets, the volume is difficult to measure because of the unknown magnitude of interstate trade in both directions (e.g., South American mahimahi is imported through the Port of Los Angeles and then flown to Honolulu). Foreign imports directly into Hawaii in 1993 were 22 million pounds worth $40 million, according to U.S. Customs; foreign exports were 850,000 pounds valued at $4.5 million. Imports comprise the entire range of species and product form. Most of the exports were fresh tuna destined either for Japan or Europe. Figures 5-7 and 5-8 and Table 5-4 summarize Hawaii's seafood imports in 1993 using detailed species and product-form information. In Figure 5-8, the term "pelagics" refers to nontuna pelagics and is dominated by the import of fresh mahimahi loins and frozen mahimahi fillets.

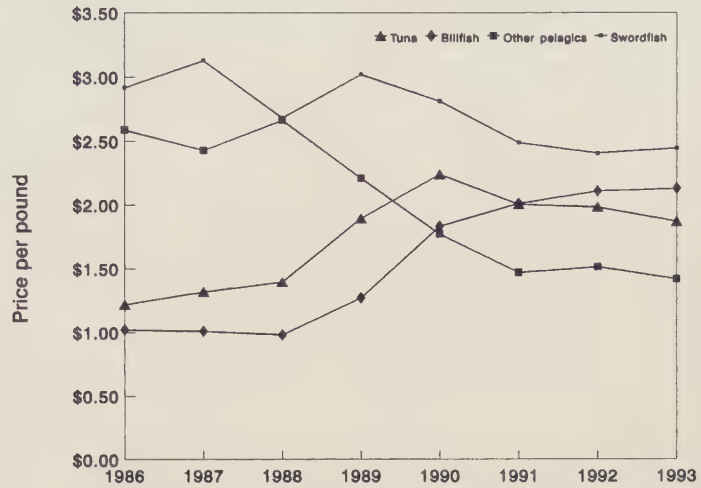


Figure 5-5
Real average price per pound for Hawaii pelagic species.

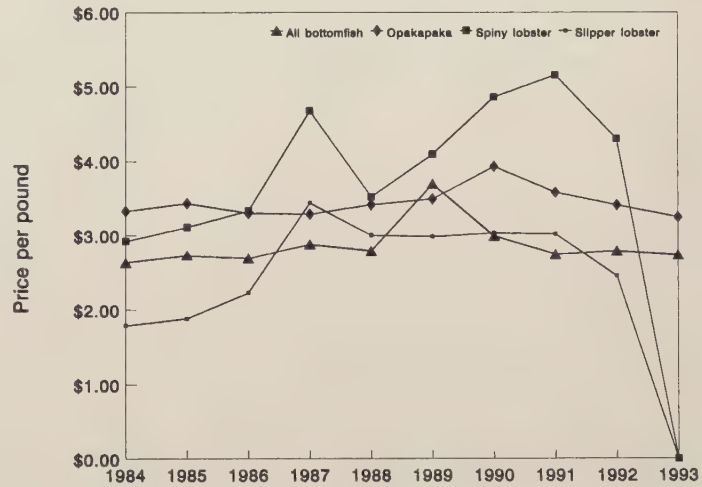


Figure 5-6
Real average price per pound for Hawaii bottomfish and lobster.

The Recreational and Subsistence Harvesting Sectors

The distinction between commercial, recreational, and subsistence fishing in Hawaii's small boat fishing fleets is primarily one of terminology. Even sportfishing charter boat captains who target blue marlin generally sell their catch.

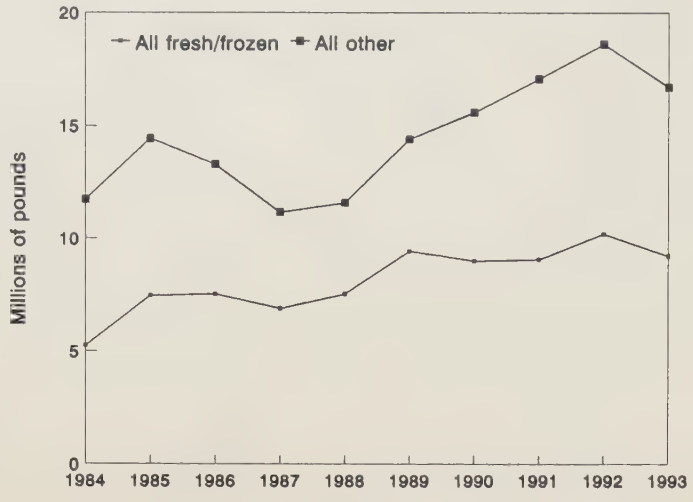


Figure 5-7
Fresh/frozen seafood imports to Hawaii.

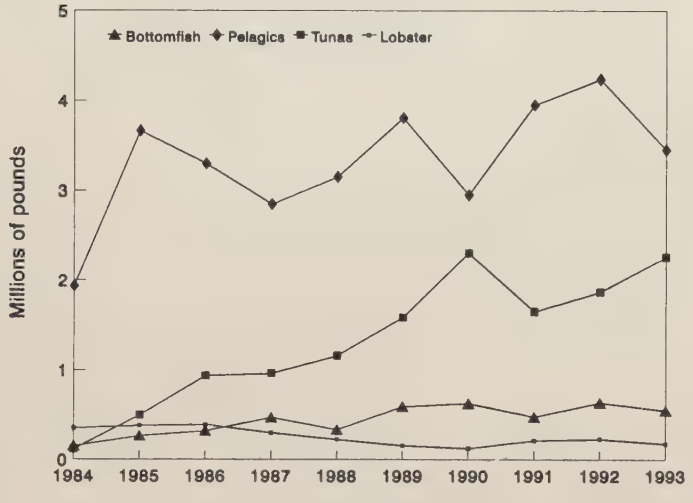


Figure 5-8
Fresh/frozen seafood imports to Hawaii, by product category.

"Weekend warriors" often keep smaller fish for home consumption or sharing among extended family and friends but sell larger fish at the local auctions. Subsistence fishing tends to operate the same way.

There have been no systematic surveys of the recreational and subsistence fisheries in Hawaii since 1979-81, but it does not appear that participation in the off-shore fishery has increased substantially. Recreational landings[8] in 1980 were estimated to be about 10 million pounds[9]. Participation in these fisheries was estimated at 320,000 people (24% of Hawaii's population) taking 708,000 boat trips. While the volume of noncommercial landings is now only a small part of total harvest, fishing plays an important cultural role in Hawaii for native Hawaiians and for more recent immigrants. Sportfishing as a tourist attraction and in tournament form is an important marine sector business.

There have been few economic studies of these sectors. Charter fishing vessels have had a hard time financially, and investment in that sector has been stagnant. However, efforts by the industry and the State of Hawaii have been made to improve marketing of charter boat fishing. Studies suggest that there are mixed motivations both for owning and operating charter fishing vessels (i.e., motivations are not entirely revenue-based) and for charter fishing patrons (i.e., motivations are not necessarily catching fish [Samples et al.[10]; Samples and Schug[11]]). Both Samples and SMS Research[12] and Meyer[13] found substantial nonmarket economic values for people participating in these fisheries.

Two important fishery management issues relate to the recreational and subsistence pelagic fisheries: first, gear and biological interaction problems between the commercial longline and non-commercial small-boat fleets were the subject of intense negotiations in 1990-91. This resulted in 25-50 mile longline area closures around the MHI[14]. Second, the commercial sale or tag-and-re-

[8]Landings by people who did not consider themselves commercial fishermen.

[9]Unpublished NMFS figures from the Marine Recreational Fishing Statistical Survey.

[10]Samples, K. C., J. N. Kusakabe, and J. T. Sproul. 1984. A description and economic appraisal of charter boat fishing in Hawaii. NMFS Southwest Fish. Cent. Admin. Rep. H-84-6C, 130 p.

[11]Samples, K. C., and D. M. Schug. 1985. Charter fishing patrons in Hawaii: a study of their demographics, motivations, expenditures, and fishing values. NMFS Southwest Fish. Cent. Admin. Rep. H-85-8C, 95 p.

[12]Samples, K. C., and SMS Research, Inc. 1983. Experimental valuation of recreational fishing in Hawaii. NMFS Southwest Fish. Cent. Admin. Rep. H-83-11C, 42 p.

[13]Meyer Resources Inc. 1987. A report on resident fishing in the Hawaiian Islands. NMFS Southwest Fish. Cent. Admin. Rep. H-87-8C, 74 p.

[14]The general problem of interaction between the Hawaii longline fleet and the small-boat pelagic fisheries in Hawaii, as well as the problems of annual variability in catch rates, is discussed in Boggs (1991) and Skillman et al. (1993).

lease of billfish (particularly marlins) by small-boat pelagic fisheries, particularly within the charter boat sports fishing community, became an issue. While several tournaments have experimented with tag-and-release, it remains controversial in Hawaii, particularly if the mortality of released billfish is high, since selling or consuming all fish is an expected part of local culture.

Finally, although not strictly a subsistence fishing matter, the issue of native Hawaiian (as well as native Chamorran in Guam) rights is of increasing interest. The WPFMC's NWHI bottomfish FMP reserves rights to be determined for native Hawaiian fishermen, and many of the near-shore fishing issues are particularly important to local communities. The WPFMC has played a leading role in attempting to identify and resolve some of these issues.

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Western Pacific Spotlight Article

Limited Entry in Hawaii's Major Commercial Fisheries

Introduction

This article discusses the evolution of limited-entry fishing in Hawaii with an emphasis on the economic impacts. Each of Hawaii's Federally managed commercial fisheries is subject to some form of limited entry. Limited entry is seen by fisheries managers and by the fishermen themselves in Hawaii as a significant regulatory measure despite doubts in the professional management literature about the effectiveness of limited entry in terms of controlling fishing effort. The experience in Hawaii suggests that when implemented fairly early in a fishery development process, limited entry can provide the basis for encouraging a sense of community amongst participants who then have a more common stake in management decisions, leading to more rational evolution of subsequent fishery regulations. The same may be true for developed fisheries on the U.S. mainland if a means for reducing the scope of each regulated fishery is found.

Hawaii has four Federally managed commercial fisheries: the Northwestern Hawaiian Islands (NWHI) lobster (spiny and slipper) fishery; NWHI bottomfish (snappers, groupers, and jacks) fisheries; the domestic pelagic longline fishery; and the deep-sea precious coral fishery[1]. Landings and revenues in the first three fisheries are depicted in Figures 1, 2, and 3. Each fishery developed rapidly in the 1980's. The growth of the two NWHI fisheries could not sustain catch rates. The growth of the pelagic longline fishery continues, with the extent of competition from foreign fishing vessels in international waters still unclear.

In the mid-1980's, the Western Pacific Fishery Management Council (hereafter referred to as the Council) began to explore limited entry options for the NWHI lobster and bottomfish fisheries in direct collaboration with vessel operators and owners. These were recently developed fisheries fairly distant from the population centers of Hawaii[2] and were based on a fairly small and narrow bottom topography. The number of commercial fishing vessels in each fishery was small (10-20). However, because the prices of the products were relatively high, the anticipated revenue of participating vessels was substantial, particularly at early catch rates.[3]

Despite the small initial number of participants in the NWHI fisheries, biological overfishing was considered possible if the profits of the early participants attracted substantial numbers of new entrants from already stressed mainland U.S. fisheries (e.g., trap fisheries in the Pacific Northwest). But more importantly for the evolution of limited entry in Hawaii, many participants in both NWHI fisheries realized that with the substantial variable costs in these fisheries[4], economic viability (i.e., maintaining catch rates and thus revenue per day at sea) was an essential fisheries management objective if the benefits of the fishery resource were to be realized over the long run.

[1]The precious coral fishery has not really operated since the implementation of the Magnuson Act in 1976 due to overfishing by foreign fishing fleets in the late 1960's and early 1970's and possible habitat destruction of these slow-growing species. Entry by domestic participants is restricted to experimental fishing permits. Only a few trips have been taken by domestic vessels under the fishery management plan.

[2]The Northwestern Hawaiian Islands (NWHI) are a string of uninhabited islets and reefs running 1,200 n.mi. west of Kauai through Midway Islands and Kure Atoll. The nearest fishery location is about 500 miles from Honolulu.

[3]For example, in 1983 ex-vessel lobster revenue per trap haul was $7.04 (unadjusted for inflation) and revenue per day fishing was $2,100, with frozen lobster tails selling for $7.41 per pound. Similarly, average bottomfish prices were $2.30 per pound (round weight) with prices for prime opakapaka (pink snapper) reaching $25.00 at Christmas and New Year's.

[4]Variable costs include per-trip run times of up to 1 week in each direction and increased annual and per trip maintenance costs associated with the substantial risks involved in breakdowns in isolated locations (several vessels have sunk in the area in recent years). As a result, generating sufficient revenues to cover fixed costs is a major operations problem.

Council management and NMFS economics staff began a series of discussions and scoping meetings with fishermen from all of Hawaii's major commercial fisheries in the mid 1980's. As a result, further efforts were made to implement limited entry for the NWHI bottomfish fishery, which would become the initial test case of limited entry in Hawaii.

Complementing this interest in limited entry, economic studies were conducted on the NWHI fisheries throughout the 1980's and into the 1990's. These studies confirmed the perception that profitability in both fisheries was sufficiently marginal that only a few vessels of moderate size would be likely to make a long-term commitment to the fisheries. Although the NMFS economists and those working for the Council collaborated in a number of areas, the management framework was designed by the Council and its staff, while the NMFS economists served primarily as "objective" sources of economic analysis. This is shown in particular by the NWHI bottomfish limited entry plan.

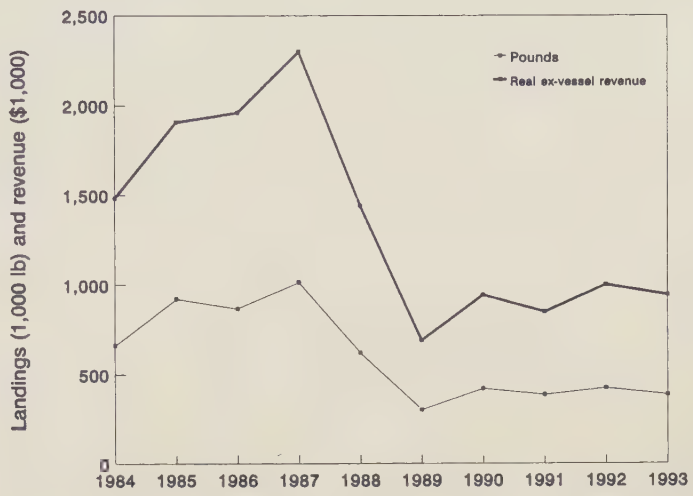

Figure 1
Hawaii bottomfish landings and real ex-vessel revenues.

NWHI Bottomfish Fishery

In the mid-1980's, the Council issued a report suggesting that a limited entry program allowing "satisficing[5]," rather than "optimizing" or "maximizing," behavior would be preferable to the participants of the NWHI bottomfish fishery (Meyer[6]). Despite the "distant-water" aspect of this fishery, participation in it was still viewed as a choice of life-style, with profitability seen as taking second place as an incentive to participate. In contrast with economic theory, and most economic practice in limited entry and other controlled access fisheries (e.g., ITQ's), a key element of the management plan was not monetizing participation in the fishery.

The Council initially approved this plan and set a control date for entry in 1985, but the actual FMP was not implemented until 1989. The basic principles were: to not allow transferability of permits (i.e., forestalling monetization of permits), and to determine the optimum number of vessels in the fishery (and thus new entry) based on average breakeven operating levels, rather than on identifying a target positive rate of profit which might be viewed by economists as economically "efficient." About 35 vessels were vested with rights to permits, and attrition was expected to winnow the number down by a sunset date of 1994.[7] Studies by NMFS economists and fishery monitoring personnel provided the detailed basis for access decisions under the limited entry program (Pooley and Kawamoto[8], Hamilton[9]). This fishery management system remains in effect today.

[5]"Satisficing" is a term created by organizational economists to suggest that people may tend to satisfy their basic wants, rather than trying to maximize their incomes as general equilibrium economic utility theory suggests. In terms of the economics of the fishing vessel as a firm, this would imply goals of maintaining a certain profit rate and an overall level of ex-vessel revenue, as well as maintaining employment opportunities.

[6]Meyer, P. A. 1987. Access control for the Northwestern Hawaiian Islands Bottomfishery." W. Pac. Reg. Fish. Manage. Counc. Rep., Honolulu.

[7]Only four vessels were active in the limited entry zone in 1993.

[8]Pooley, S. G., and K. E. Kawamoto. 1990. Economic analysis of bottomfish fishing vessels operating in the Northwestern Hawaiian Islands, 1984-88. NMFS Southwest Fish. Cent. Admin. Rep. H-90-13, 20 p.

[9]Hamilton, M. 1994. NWHI bottomfish fishery 1993 vessel activities, costs, and economic returns. NMFS Southwest Fish. Cent. Admin. Rep. H-94-1C, 36 p.

NWHI Lobster Fishery

The participants in the NWHI lobster fishery initially resisted appeals for limited entry or individual transferable quotas (ITQ's) in their fishery. They felt that high variable costs would reduce the risk of biological overfishing (i.e., that the fishery would regulate itself economically). Throughout the 1980's and into the 1990's, these participants have, on the whole, preferred a management structure which allowed risk-taking behavior: a jackpot approach to competition with their fellow participants instead of specified catch levels (e.g., set by ITQ's). An initial cost-earnings assessment conducted by NMFS economics and fishery monitoring staff (Clarke and Pooley, 1988) and a subsequent bioeconomic model (Clarke et al., 1992) suggested that the idea of economic self-management was not far-fetched in the sense that the open-access level of fleet operations was relatively close to the maximum sustainable yield level of operations.

However, with the rapid development of the Hawaii pelagic longline fishery (first for yellowfin and bigeye tuna and then for swordfish) in the late 1980's, the potential existed for longliners to participate in the NWHI lobster fishery on a seasonal basis. These longliners were hypothesized to be able to cover their variable costs without having to cover all of their fixed costs in the lobster fishery, providing a more continuous stream of income to their crews and owners. Combined with the first evidence of recruitment failure in the NWHI lobster stocks, this provided the incentive for NWHI lobster vessel captains and owners to craft their own limited entry program, codified by the Council in 1991.

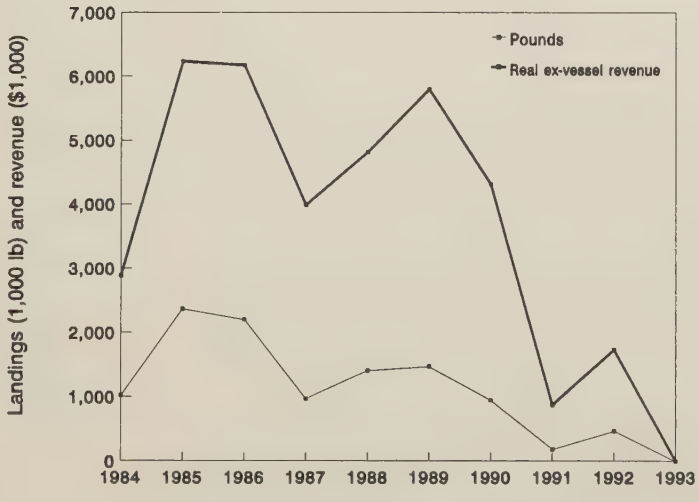

Figure 2
NWHI lobster landings and real ex-vessel revenues.

In contrast with the NWHI bottomfish program, the lobster program did include transferable permits, acknowledging the greater "commercialism" of the lobster fleet's owners. Fifteen vessels were vested with rights to NWHI lobster fishing permits, with approximately 12 vessels fishing on an annual basis. One feature of the bottomfish program was maintained, notably the requirement to use one's license at least once every two years. This provided exactly the kind of negative incentives that economic theory predicts: when catch rates dropped due to an unexpected decline in recruitment to the lobster stocks, some vessels were forced to continue fishing to maintain their permits (Townsend and Pooley[10]).

Hawaii's Domestic Longline Fishery

Finally, in 1991, the rapid growth of the domestic pelagic longline fishery in Hawaii, populated largely by new entrants from the U.S. east and Gulf coasts, encouraged some fishery managers and competing segments of the near-shore pelagic fishery (primarily small-scale commercial and recreational trollers and handliners, including charterboats) to call for a moratorium in the longline fishery. This moratorium lasted 3 years and in 1994 was transformed into a formal limited entry program with transferable permits.

The moratorium was designed to reduce competition between the longline fishery and the near-shore pelagic fisheries and to provide some conservation leeway in the blue marlin and swordfish fisheries, by reducing the bycatch of tuna and blue marlin. However, the regulatory impact analysis for the moratorium regulations found little empirical basis for the regulation and suggested that the potential costs to the longliners exceeded the benefits to the near-shore pelagic fisheries (Pooley, 1994). Economic dislocation occurred during the moratorium period when permits had only limited transferability. Nonetheless, as the

[10]Townsend, R. E., and S. G. Pooley. 1994. A proposal for corporate management of the Northwestern Hawaiian Islands lobster fishery. Pap. pres. at Am. Fish. Soc. annu. meet.

difficulties and costs in operating in Hawaii's distant-water pelagic longline fishery became more apparent to the new entrants, it also became apparent that the moratorium, and the subsequent limited entry program, provided a "controlled growth" environment. This would provide greater economic stability for the industry as a whole and make the implementation of biologically oriented fishery measures more amenable.

Conclusions

Limited entry has not been a panacea for any of the Hawaii Federally regulated commercial fisheries. As indicated by Figures 1 and 2, neither of the two NWHI fisheries has prospered in terms of maintaining total revenue from the fisheries. In neither fishery were the population dynamics well understood. Although maximum sustainable yield (MSY) figures were available for both fisheries, factors affecting these fish stocks were not well known. Thus for the lobster fishery, unexpected oceanographic perturbations substantially reduced population levels in the early 1990's, greatly reducing the scope of the commercial fishery (Polovina and Mitchum, 1992; Polovina et al., 1994). For the bottomfish fishery, the lack of detailed fishing information made assessment of annual variation in catch rates and fish sizes difficult as the participating vessels moved up the chain and explored new fishing grounds. In 1993, the lobster fishery was closed because of the stock recruitment problems, and landings in the bottomfish fishery had fallen by 50% from the peak in the mid 1980's.

However, as suggested by the estimated revenue per day fished (Figure 4), income has been more stable (while nonetheless quite variable). Moreover, the potential value of the permits has made rebuilding the NWHI fisheries economically viable, with a number of participants in the NWHI lobster fishery agreeing on multi-year closures if required. For the pelagic longline fishery, detailed empirical economic analysis is just beginning to reveal the dynamics of this industry.

Systems of limited entry are not known to achieve economic efficiency or to reduce fishery harvests in the presence of biological overfishing. Nonetheless, limited entry has its advantages, especially when compared to open-access fisheries and to the monitoring and enforcement costs of complex biological, economic, and operational

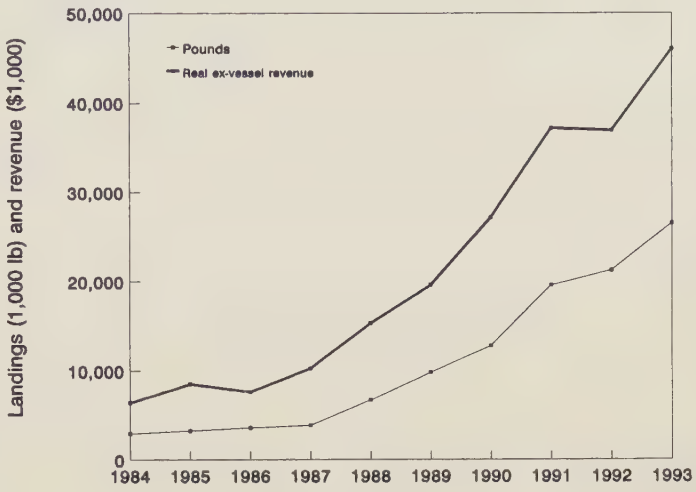

Figure 3
Hawaii longline landings and real ex-vessel revenues.

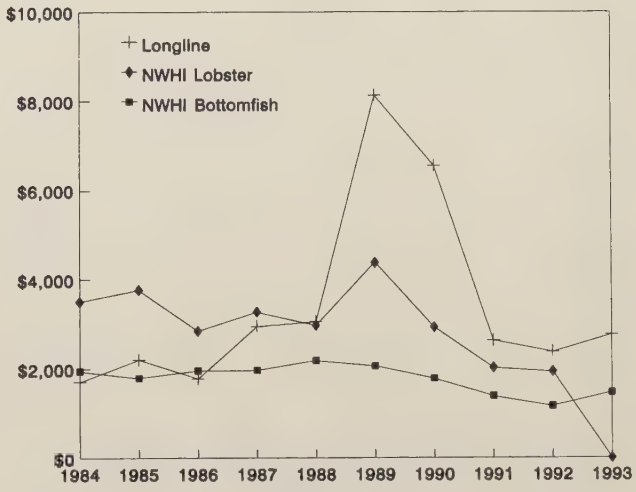

Figure 4
Hawaii commercial fisheries real daily revenue per vessel, by fishery.

regulations. This is particularly true if the limited entry program incorporates a simple system for reducing effort, e.g., fractional licensing (Townsend and Pooley, 1994)[11]. Despite what many might consider suboptimum economic performance in the two NWHI limited entry fisheries, and the ap-

[11]Fractional licensing is a system by which participation in a fishery is regulated by inputs (e.g., tradable fractions of permits) rather than outputs (e.g., ITQ's).

parently marginal economic benefits of limited entry in the longline fishery, the consensus in Hawaii is that the relatively early presence of limited entry developed a stronger sense of community in the fisheries and provided a better basis for working out subsequent fishery management problems. It is this latter point which is perhaps generalizable to the more established fisheries on the U.S. mainland.

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Chapter 6

The Southeast Regional Report

The Commercial Harvesting Sector

Basic Economic Issues

The Southeast Region of the United States supports a large and diverse harvesting and processing industry for marine fisheries. Fleets in eight states from Texas to North Carolina, Puerto Rico, and the U.S. Virgin Islands land hundreds of species of finfish and shellfish, with the shrimp fisheries by far the most important in terms of total revenues. In 1994, there were about 2.44 billion pounds of landings valued at about $1.03 billion and shrimp accounted for 235 million pounds of the landings valued at $531 million. Other important commercial fisheries include menhaden, blue crab, reef fish, oysters, spiny lobster, mullet, highly migratory species, and coastal pelagics.

The most important factors influencing the economic performance of the commercial fishing industry in the Southeast Region can be categorized as follows:

1) A major portion of the stocks are being harvested at less than their long term potential yield (LTPY) (USDOC, 1993, provides a full definition).

2) Most of the fisheries are overcapitalized in the sense that more harvesting effort than is necessary is employed to catch a given amount of the stock.

3) There are multiple, competing uses of the stocks, and these competing uses complicate management and raise the cost of management.

4) Most of the management regimes for the stocks feature controls, usually overall quotas, that have been largely successful in beginning to halt or reverse stock declines.

5) However, in most cases there are no overall controls on effort and a number of gear, trip limit, size, and other regulations tend to reduce harvesting efficiency and redistribute existing fish stocks with the result of increasing the costs of harvesting, management, enforcement, and monitoring.

6) From a marketing viewpoint, a number of the stocks face market competition from imports of identical or similar species, and prices are often dictated not only by the supply of imported products but by the state of the world economy as well.

7) Probably because the world supply of fishery products cannot be easily increased in response to favorable market signals and because the U.S. demand for seafood products has shifted upwards based on perceived nutritional benefits of seafood consumption, there has been a general tendency for southeastern U.S. seafood prices to increase faster than the rate of inflation. However, a notable exception is that the real price of shrimp has tended to decline in recent years, largely because world shrimp supplies have grown via mariculture.

While some commercial fisheries in the Southeast Region are exclusively or largely the domain of one user group, most fishery resources are exploited by a number of competing commercial and recreational user groups. In heavily utilized open-access fisheries, this leads to allocation problems and a variety of user conflicts that have economic consequences. These issues are difficult to quantify, and as a result it is difficult to address the complex management problems which arise when a diverse group of users with different objectives and harvesting methods are participating in the catch. While most observers tend to think of the competition in terms of the number of harvesters competing directly for the use value of the resources, the finfish bycatch in the Gulf of Mexico shrimp fishery provides a case where the use by one sector, shrimp harvesters, is not intentional. In this particular case, the bycatch is of such magnitude that the stock effects on the finfish resources have profound biological and economic implications for those recreational and commercial fishermen who directly target the bycatch species. For one fishery, red snapper, it has been determined that unless the mortality that results from shrimp harvesting can be decreased by 50%, then the resource cannot recover in any reasonable period of time even if all directed recreational and commercial harvest ceased. (This region's spotlight article provides for a more thorough discussion of

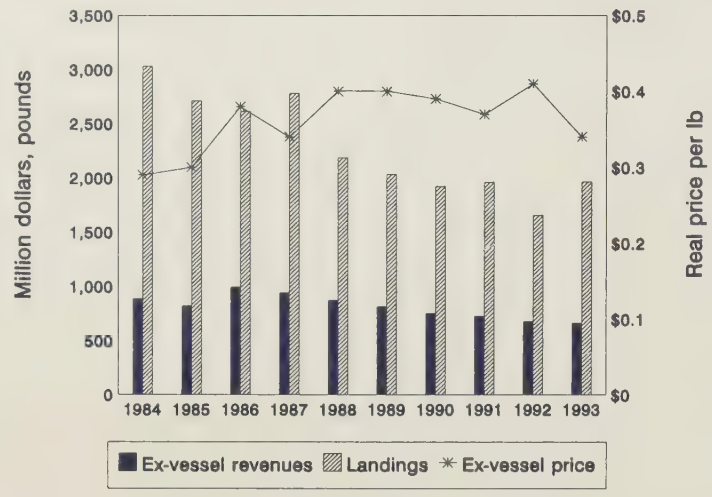


Figure 6-1
Real revenues, landings, and ex-vessel prices for all Southeast fisheries.

A Florida shrimp boat (NMFS photo by William Antozzi).

the management regime for red snapper and how it is impacted by the shrimp bycatch situation.)

As is relatively common in fisheries throughout the United States and the world, the exploitation of open-access marine fishery resources in the Southeast Region has resulted in overcapitalization in the harvesting sector for a number of species. As the term is used here, overcapitalization does not necessarily imply a level of fishing effort that creates a biological overfishing scenario, but instead is meant to imply that effort levels have expanded to the point where a given level of harvest could be produced at a lower cost. The region's shrimp fisheries are prime examples wherein the stocks are not biologically threatened, but where shrimp harvesting effort, by almost any accounting, is far in excess of that needed to harvest the annual shrimp crop. When Ward (1989) compared the optimal fleet size to the actual fleet size in the Gulf of Mexico shrimp fishery, his results indicated that fleet size in the open-access shrimp fishery at that time was more than three times as large as it would be in a controlled-access fishery generating the maximum level of profits. Vessel crowding, often cited as a symptom of overcapitalization, was investigated by Ward and Sutinen (1994) by using fleet size as a measure of the crowding externality (Chapter 1 provides a definition) for the Gulf of Mexico shrimp fishery. One of their main results was that crowding had a highly significant, negative impact on a fisherman's decision to enter the fishery, further indirect evidence supporting the extent of overcapitalization in this fishery.

For most of the period following the implementation of the Magnuson Fishery Conservation and Management Act (MFCMA), fishery managers tended to design and implement regulations that had the major objective of restoring depleted fish stocks or at least maintaining them at current levels. Unfortunately, most of the regulations did not fully address the improvement of net economic benefits which could potentially be derived from the fisheries. In general, the regulations led to shortened fishing seasons, increased capital investment, and an overall decline in harvesting efficiency. However, fishery managers in the Southeast Region are now beginning to take steps leading to the implementation of overall effort controls. Management regulations that attempt to address some of the open-access resource management problems in the Southeast Region began with the imposition of a permit moratorium for the reef fish fishery, which successfully froze entry into the fishery. Following the moratorium, reef fish vessels that were sold with a permit have commanded a $5,000-10,000 premium over vessels sold without the permit. That is, the permit acquired market value, as expected. However, this transferable pseudolicense limitation program did not prevent the expansion of fishing effort by fishermen already in the fishery, nor did it address the derby fishing problem. Noting these outcomes, the Gulf of Mexico Fishery Management Council developed, approved, and is ready to implement an ITQ program for the red snapper fishery.

An ITQ program developed by the South Atlantic Fishery Management Council for the wreckfish fishery has been successful in lowering costs and increasing unit prices as forecast. The wreckfish ITQ program caused fishermen in the fishery to behave as if they owned the resource. While not actually transferring a property right for the resource in the sea to the wreckfish fishermen, fishing effort and participation levels in the fishery have declined over time. Ex-vessel prices have increased with an improvement in the quality of landed fish, and resource rents that were dissipated have been reallocated from the quasi-fixed factor inputs of capital and labor to the relatively more fixed ITQ management instrument.

Beyond these very definitive developments, early discussions by state and Federal management agencies are underway to investigate effort controls for king and Spanish mackerels, deepwater snapper/grouper, spiny lobster, and stone crab. These developments indicate clear progress toward resolving open-access fishery problems in the Southeast and thereby measurably improving the economic status of those fisheries.

As management regimes designed to control overall effort are implemented, the actions should set the stage for an indirect and additional positive outcome in terms of the economic performance and efficiency of the fisheries. This would be manifested by a reduction in the number of regulations that have come into being since the implementation of the Magnuson Act. These other controls, which include trip limits, seasonal closures, area closures, size limits, numerous gear restrictions, income qualifiers, complex reporting requirements, and multiple permits, were successively introduced over a period of years in an attempt to address symptoms of the open-access fishery management problem. It is becoming increasingly clear that although some of the regulations led to demonstrated short-run, positive net economic benefits, in aggregate, the same regulations created conditions which led to a dissipation of the gains with the end result of zero or negative net economic benefits in the fishery after a number of years. Further, it has become almost axiomatic that the regulations tend to foster additional regulations once it is realized that the expected benefits do not appear or are dissipated.

Overview of Southeast Region Fisheries

Figure 6-1 illustrates the trends in real ex-vessel revenues and landings for all Southeast Region fisheries from 1984-93, while Table 6-1 shows 1984-93 landings, real value, and prices for shrimp, menhaden, blue crab, reef fish, oysters, spiny lobster, mullet, highly migratory species (tuna, swordfish, and sharks), coastal migratory pelagics (mackerels and other species), and all other species combined. The named species or species groups accounted for 93% of the landings and 86% of the value of all Southeast Region fisheries in 1993.

Table 6-1
Volume (million pounds), real value (million 1987 dollars), and real price (1987 $/lb) of commercial fishery landings in the Southeast Region[1].

Species	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Shrimp										
Volume	276	292	331	284	251	268	286	266	247	237
Real value	$510	$486	$647	$523	$447	$409	$414	$418	$360	$324
Real price	$1.85	$1.67	$1.95	$1.84	$1.78	$1.53	$1.45	$1.57	$1.46	$1.36
Menhaden										
Volume	2,338	2,053	1,905	2,068	1,485	1,354	1,264	1,332	1,014	1,283
Real value	$102	$74	$72	$73	$73	$51	$45	$53	$44	$50
Real price	$0.04	$0.04	$0.04	$0.04	$0.05	$0.04	$0.04	$0.04	$0.04	$0.04
Blue crab										
Volume	110	102	93	131	135	108	116	125	133	127
Real value	$31	$29	$29	$47	$50	$39	$39	$36	$50	$48
Real price	$0.28	$0.28	$0.31	$0.36	$0.37	$0.36	$0.33	$0.29	$0.37	$0.38
Reef fish[2]										
Volume	33	32	36	37	38	42	43	37	36	40
Real value	$44	$44	$51	$49	$50	$54	$53	$45	$43	$50
Real price	$1.31	$1.40	$1.40	$1.33	$1.31	$1.29	$1.22	$1.20	$1.19	$1.24
Oysters										
Volume	30	28	24	21	19	17	13	13	17	19
Real value	$51	$46	$46	$52	$45	$44	$40	$29	$31	$27
Real price	$1.68	$1.62	$1.93	$2.52	$2.34	$2.58	$3.05	$2.22	$1.83	$1.43
Spiny lobster										
Volume	6	6	5	6	6	8	6	7	4	5
Real value	$17	$15	$14	$22	$17	$21	$18	$23	$14	$15
Real price	$2.76	$2.57	$2.73	$3.61	$2.65	$2.70	$3.00	$3.33	$3.10	$2.73
Mullet										
Volume	27	24	31	29	32	34	36	30	30	37
Real value	$8	$7	$11	$9	$13	$13	$13	$10	$11	$15
Real price	$0.29	$0.29	$0.34	$0.32	$0.40	$0.39	$0.36	$0.32	$0.37	$0.39
HMS[3]										
Volume	8	11	15	23	40	37	30	25	36	30
Real value	$16	$19	$23	$46	$66	$56	$50	$38	$39	$33
Real price	$2.02	$1.80	$1.51	$1.96	$1.66	$1.49	$1.66	$1.50	$1.08	$1.08
CMPS[4]										
Volume	18	17	19	20	19	17	19	20	18	19
Real value	$8	$9	$10	$10	$9	$9	$10	$10	$10	$11
Real price	$0.45	$0.54	$0.52	$0.52	$0.50	$0.53	$0.53	$0.49	$0.53	$0.56
Other										
Volume	186	148	153	161	162	149	108	107	122	170
Real value	$101	$88	$90	$106	$102	$114	$70	$62	$73	$92
Real price	$0.54	$0.59	$0.59	$0.66	$0.63	$0.77	$0.65	$0.58	$0.60	$0.54
Total										
Volume	3,032	2,712	2,613	2,780	2,187	2,034	1,922	1,963	1,659	1,969
Real value	$887	$817	$992	$939	$871	$811	$752	$724	$675	$663

[1]Source: NMFS, Southeast Fisheries Science Center, accumulated landings data file.
[2]Reef fish include snapper, grouper, and other species.
[3]HMS = Highly migratory species include swordfish, tuna, and shark.
[4]CMPS = Coastal migratory pelagic species include king and Spanish mackerel and other species.

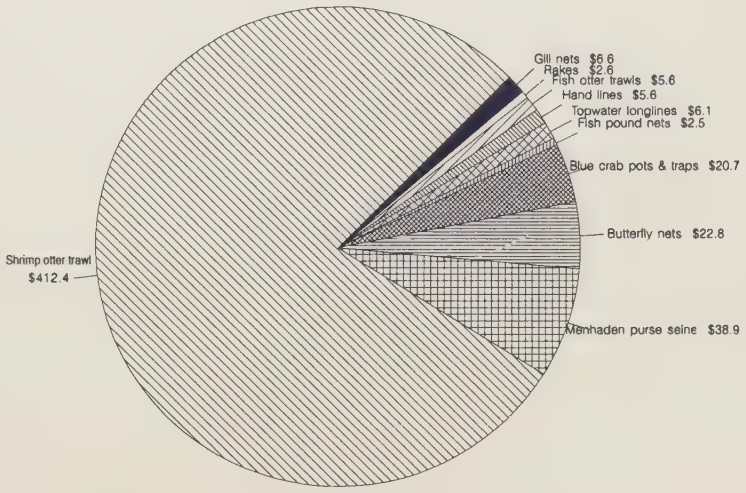


Figure 6-2
Ten most important gear types in Southeast fisheries by revenue earned in 1992.

Table 6-2
Number of fishing craft (vessels and boats) employed in all Southeast fisheries, and number of vessels in the Gulf of Mexico shrimp fishery.

Year	Southeast (all fisheries)	Gulf of Mexico shrimp fishery
1984		5,636
1985		5,670
1986		5,633
1987		5,725
1988		5,897
1989		6,250
1990	37,259	5,828
1991	38,766	5,791
1992	40,204	5,063
1993	41,062	4,928

While it is tempting to look at the overall trends in landings for a specified period of time as an overall indicator of the economic performance of the fisheries, Figure 6-1 and Table 6-1 provide excellent illustrations of the sometimes misleading conclusions that can be reached. For example, while the figure and table indicate that southeastern landings are highly volatile, a closer examination shows that menhaden dominates the landings and menhaden landings have varied by over 100% during the periods examined. Hence, the landings trend is highly misleading. A more realistic picture of economic performance can be gained by examining the economic performance of the individual and collective fisheries, but such an examination requires information on overall effort and the cost of that effort, and such data have only recently become available for the Southeast. The data are now available for the shrimp and reef fish fisheries, but they have not yet been analyzed. The tentative conclusions from the data are that the shrimp fisheries have declined in terms of economic performance over the last 10 years or so. The reef fish fisheries appear to have peaked during the early 1980's in terms of profitability and other economic indicators. Even though the reef fish fisheries may have declined in terms of economic performance since the early 1980's, the Southeast spotlight article indicates that they may improve in the future as forward-looking controlled-access management regimes go into place. As mentioned previously, one of the keys to understanding the economic performance of the fishing industry is to examine effort and the cost of effort. While generic information regarding the overall cost of effort is not available, recent changes in fishing effort levels in the Southeast are suggested by the total number of fishing craft employed. For example, Table 6-2 indicates that the number of craft increased by about 4,000 during 1990 to 1993, and this may indicate a rise in total fishing effort and hence in the total costs of fishing. Once again, though, indicator variables may be misleading. Table 6-2 also shows that the number of vessels engaged in the shrimp fishery appears to be declining.

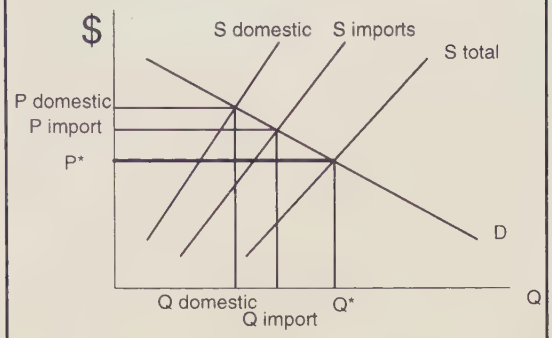
An alternate approach to indicators of fishery performance might be gained via an examination of the gears employed in the fisheries. Figure 6-2 shows the share and revenues generated by the ten most valuable gears used in the Southeast in 1992. The figure clearly indicates that the shrimp otter trawl was the most important fishing gear in terms of the value of landings, and purse seine gear was the leader in terms of volume. Since it has already been established that the shrimp fishery is the most important in terms of value, and the menhaden fishery is the most important in terms of landings, it makes sense that the gear approach may lend additional information about the general state of the fisheries. In particular, note that the shrimp otter trawl gear type generated landings over 10 times more valuable than the menhaden purse seine, the second ranked gear, and 200 times the revenue generated by fish pound nets, the tenth ranked gear in 1992. Similar observations can be made regarding the importance of purse seine gear in the volume of landings.

Given the mixed results in potential trends in overall Southeast landings and value and the indication that total costs of fishing may have increased, it may well be that the net incomes of the average Southeast fishermen have been decreasing in recent years. While NMFS does not collect basic harvesting cost information for all of the affected fisheries, it is likely, or reasonable, to suppose that the profit margins for individual firms may also be declining. For example, a recent economic assessment of the Gulf of Mexico shrimp fishery (Ward and Nance[1]) found a steady decline in net revenue per vessel (see following section for further description).

Regardless of the current and recent overall economic performance and status of the southeastern U.S. fisheries, there has been some degree of success by fishery managers to begin to reverse stock declines. If, as indicated earlier, regulators are now moving in the direction of managing for the longer term economic performance of the fisheries by instituting controls on the overall levels of harvesting effort, the future of the Southeast fisheries possesses the potential for major improvement in net economic benefits over the next 10 years as opposed to the previous years. A caution or caveat is that the effort controls have to be instituted broadly and, at the same time, a number of the current regulations that tend to result in harvesting inefficiencies, while raising the cost of management, have to be removed.

The Southeast Shrimp Fishery

The shrimp fishery in the Southeast Region is considered to be among the most important U.S. fishery resources, and is certainly the most important resource in the Gulf of Mexico. Real ex-vessel prices for shrimp in the Gulf of Mexico increased 86% between 1950 and 1992. However, ex-vessel prices have declined 36% since the 1979 peak, primarily due to a 1,470% increase in shrimp imports. Domestic shrimp landings in the Gulf of Mexico ranged from 134 to 304 million pounds live weight between 1950 and 1992. Landings have gradually increased from an annual average of 196 million pounds between 1950 and 1960 to an average of 274 million pounds between 1984 and 1993 (Table 6-1). In 1991, shrimp landings comprised 15% of total finfish and shellfish landings, but 57% of its total value. Griffin and Jones (1975) found that the shrimp fishery contributed over $63 million to the Texas economy and supported over 6,000 jobs in 1971. Kearney/Centaur[2] estimated economic impacts for the South Atlantic and Gulf region to be 73,263 jobs generating over $909 million in income and $1.4 billion per year in value added.



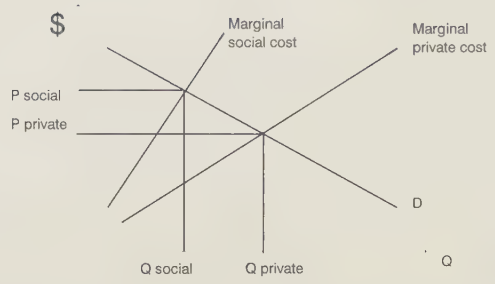
The total supply of shrimp to the U.S. market is the sum of domestic supply and imports. Note that the equilibrium price is much lower than it would be without imports. Shrimp ex-vessel prices have declined 36% since 1979 due primarily to imports.

In the Gulf of Mexico shrimp fishery, vessel fleet size increased until 1989 (Table 6-2). After 1989, vessel fleet size began to decline, probably due to the decline in ex-vessel prices and a decline in average net revenue per vessel. Crew size in the Gulf of Mexico shrimp fishery remained relatively stable at about 2.5 crew members per vessel prior to 1989. After 1989, with the decline in fleet size, crew size per vessel began to increase, exceeding 2.6 in 1992. While these changes in fleet size and crew levels are generally believed to be caused by shifts in relative abundance of different species of fish, ex-vessel prices, and variable costs, explaining these trends with any certainty is not possible at this time.

The shrimp fishery has faced and is facing a unique set of problems. The open-access nature of the fishery led to a decline in vessel productivity

[1]Ward, J. M., and J. Nance. 1994. 1994 update to the stock assessment and fishery evaluation (SAFE) report for the Gulf of Mexico shrimp fishery. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, 9721 Executive Center Drive, North, St. Petersburg, FL.

[2]Kearney/Centaur. 1984. Economic impact of the commercial fishing industry in the Gulf of Mexico and South Atlantic regions. Gulf S. Atl. Fish. Develop. Found., Inc., Final Rep. 202 p.



Shrimp bycatch: There is a divergence between the social and private costs for shrimp fishing since the bycatch costs are not included in the cost of harvest. If the total costs were considered, less shrimp would be caught and a higher price would be paid.

that was documented as early as the late 1950's (Osterbind and Pantier[3]). Marine turtle and finfish bycatch is indirectly caused by the open-access nature of the fishery. Turtle excluder devices (TED's) were developed to comply with the requirements of the Endangered Species Act. Bycatch reduction devices (BRD's) are a proposed method to reduce the incidence of finfish bycatch in shrimp trawls. However, Ward and Macinko[4] demonstrated that the BRD's alone will not lead to the conservation of finfish stocks in open-access fisheries. Lastly, the development and adoption of fishery management plans for shrimp (Texas Closure) and other species since 1980 and the closure of the Mexican shrimp fishing grounds due to the adoption of a 200-mile limit (Griffin and Beattie, 1978) have led to the reallocation of fishing effort between fisheries and between fishing grounds (Fonyo et al.[5]) that has increased competition for limited domestic supplies of shrimp.

External economic influences have also impacted the shrimp fishery. Accompanying the decline in real ex-vessel prices has been an increase in real input costs since the late 1970's. Fuel prices increased substantially in the early 1970's and had a significant impact on shrimp vessels' variable costs and net revenues (Griffin and Nichols, 1976). By 1980, the extension of Mexico's jurisdiction to 200 miles eliminated access to shrimp fishing grounds that had been heavily utilized by U.S. shrimp fishermen (Blomo et al., 1978). Lastly, the expansion in shrimp aquaculture and imports of shrimp to the United States have depressed ex-vessel prices shrimp fishermen receive for their catch (Vondruska[6]) and even stimulated the creation of a futures market for shrimp.

ITQ's in the Wreckfish Fishery

After a period of unrestricted development in the South Atlantic wreckfish fishery, concerns were expressed that the stock may have already or soon would become overexploited. Regulations establishing a total allowable catch (TAC) were quickly followed by trip limits and a closed season to protect spawning stocks. However, these types of fishery management regulations tend to encourage increased capitalization of the fishing fleet. Management regulations that would encourage efficient harvesting operations were sought to reduce capitalization and participation in the fishery; consequently, individual transferable quotas (ITQ's) were suggested and adopted as a management option beginning in January 1992. Because the wreckfish fishery was believed to be a single-species fishery operating in a small, well-defined area, with no recreational fishery component, a small number of commercial fishermen, and little or no bycatch of other species, it appeared to be an excellent candidate for an ITQ fishery management program.

By most accounts, the program has been successful. The fishing effort level at the beginning of the fishing season has decreased (Fig. 6-3). The number of fishermen in the fishery has declined from 49 initial shareholders to 26 as of May 1994. The number of trips per month has also declined since the ITQ system was implemented. This is directly related to the reduced number of vessels now participating in the fishery. Monthly trips were fairly constant during the last 5 months of the 1993-94 season.

Average ex-vessel prices have increased since the ITQ system was implemented (Fig. 6-4), per-

[3]Osterbind, C. C., and R. A. Pantier. 1965. Economic study of the shrimp industry in the Gulf and South Atlantic states. Final Rep., Contr. 14-17-008-118, to Bur. of Commer. Fish, Fish Wildl. Serv., Wash., D.C.

[4]Ward, J. M., and S. Macinko. 1993. Using theory: rethinking fisheries bycatch problems. Pap. pres. at Int. Conf. Fish. Econ., Os, Norw., May 26-28.

[5]Fonyo, C. M., J. A. Browder, and S. L. Brunenmeister. 1983. Dynamics of the Gulf of Mexico shrimp fleet, 1981. U.S. Dep. of Commer., NOAA, Natl. Mar. Fish. Serv., 75 Virginia Beach Drive, Miami, Fla.

[6]Vondruska, J. 1992. Southeast shrimp fishery market conditions, 1991-1992. Natl. Mar. Fish. Serv., Southeast Reg. Off., Dec., Prelim. Draft Report, 16 p.

haps reflecting the improved quality of wreckfish landings under the ITQ program. The 1993-94 season experienced relatively constant monthly prices, an indication that some level of stability has been attained in terms of a better match between seasonal demand and supply.

Monthly landings do exhibit less variation under the ITQ program. The total catch for each season has declined since the ITQ was adopted (Fig. 6-5). Various factors not necessarily related to stock density could be responsible for the decline in total catch during each season. At present, only assumptions can be made as to the reasons for the decline. However, catch per unit of effort has not declined in the fishery since the adoption of ITQ's. Figure 6-6 shows that landings during the first month of fishing were much lower for the two seasons after implementation of the ITQ program than landings before ITQ's were adopted (the 1991-92 season), indicating that a solution to the race for fish has been found.

The utilization rate of ITQ shares seems to be increasing. Table 6-3 shows a breakdown of how shares were utilized by the shareholders. During the 1991-92 season (pre-ITQ), 91 wreckfish vessel permits were issued, and of those, 44 reported wreckfish landings. The number of permits issued dropped to 40 for the 1992-93 season with 22 reporting landings, and to 23 for the 1993-94 season with 19 reporting landings. Twenty-one vessels were issued permits for the 1994-95 season, and so far 11 have reported landings. There has been a net change of 23 shares in 22 transactions from April 1992 to May 1994. Twenty-nine shareholders have sold their shares and six shareholders have entered the fishery. The value of the permanent ITQ shares and annual coupons is currently estimated at nearly $1 million. This figure represents the net present value of the stream of net revenues the fishery is capable of generating over time.

Table 6-3
Utilization of ITQ shares by shareholders.

Item	1992-93	1993-94
Number of active shareholders	38	26
Didn't use shares	26%	23%
Used 1-50% of shares	21%	23%
Used 51-99% of shares	11%	31%
Used 100+ % of shares	16%	8%
Sold shares	26%	15%

With the initial allocation of ITQ's to fishermen based equally on harvest history and participation in the fishery, those fishermen who elected to exit the fishery were compensated by those fishermen who desired to remain in the fishery or who wished to enter the fishery. Under the ITQ program, the "winners" compensated the "losers" as the fishery was transformed from a common property resource to one in which fishermen behaved as if property rights for fish in the sea existed.

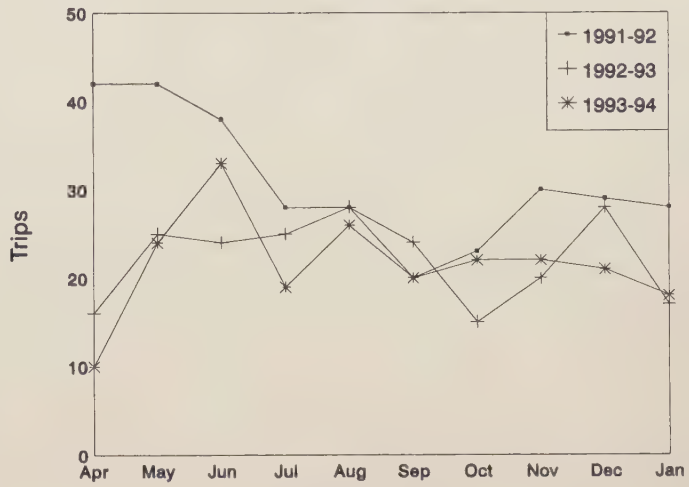


Figure 6-3
Number of wreckfish trips.

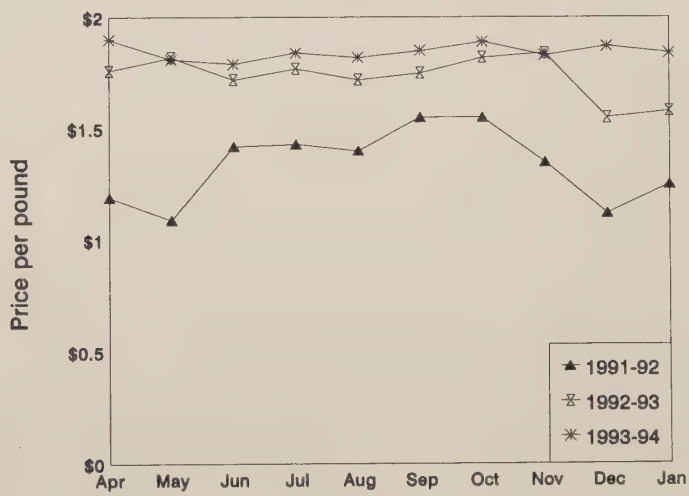


Figure 6-4
Ex-vessel prices of wreckfish.

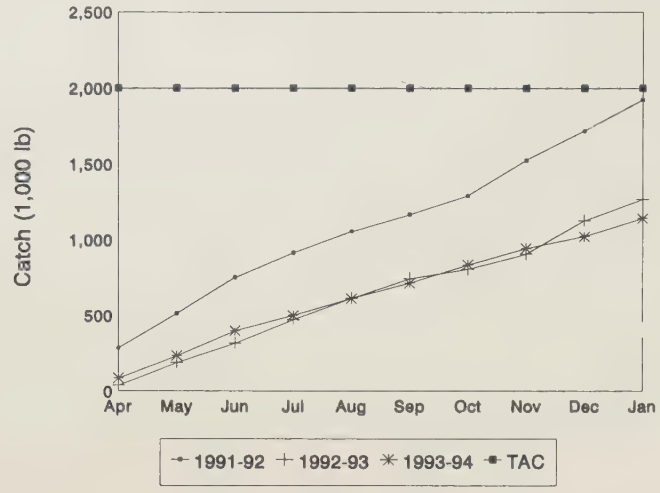


Figure 6-5
Accumulated wreckfish catch by season (whole weight).

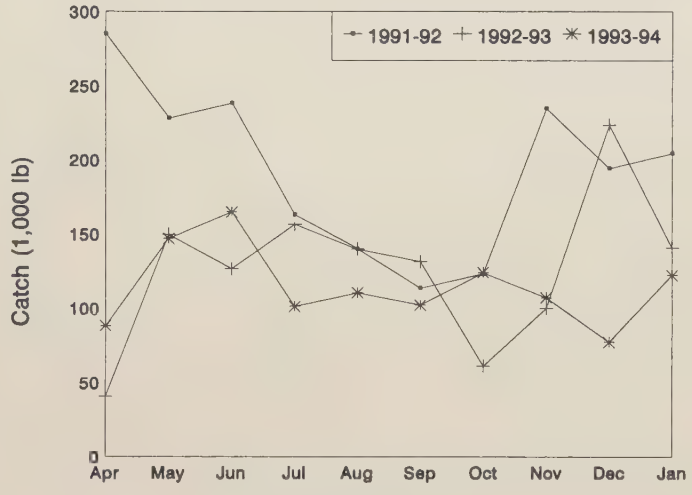


Figure 6-6
Wreckfish catch by season (whole weight).

That winners compensate the losers without government interference is an important outcome of ITQ management programs.

The ITQ program has indicated two key issues with ITQ management. The first issue is the importance of the setting of the TAC. While TAC was nearly achieved prior to the ITQ program, it has not been approached since the adoption of the ITQ program. Since the TAC determines the total supply of ITQ coupons, an excess supply will act to depress ITQ prices. Lower ITQ prices will attract entrants to the fishery or maintain the fleet at a higher than optimal size. Eventually, improvements in market conditions will result in increased demand for ITQ's and ITQ prices will increase as a result. For new ITQ programs, it is important that TAC levels are set to reflect optimum yield from the fishery to minimize the time it takes to stabilize the market.

The second key issue concerns assumptions on fishermen behavior. It was believed that the wreckfish fishery was a single-species fishery, and the predicted change in fishing behavior as a result of an ITQ program was that individual fishermen would fish less intensely. Diversification of fishing operations to other fisheries was not anticipated. However, fishermen left the ITQ fishery to operate in more profitable alternative fisheries or to establish participation records in other fisheries where ITQ programs were being considered. When the catch rates in these fisheries declined, they returned to the wreckfish fishery. Fishermen in those alternative fisheries had to bear the costs of increased competition for their fixed fishery resource. As a result, the benefits generated in the wreckfish fishery are mitigated by the costs imposed on other fisheries. Better socioeconomic information about the past fishing behavior of fishermen needs to be collected to anticipate the degree of switching behavior induced by the change in management institutions. This information would include the characteristics of the vessel or boat and the fishermen and past economic information on revenue and variable costs on an individual firm basis.

Overall, the wreckfish fishery is behaving like a competitive market. The externalities of resource rent dissipation and fleet overcapitalization have been corrected by eliminating the open-access market failure. With use rights in a free and competitive market, fishermen can make long-run investments in the form of stock conservation. The vesting of fishermen means that management regulations can be less stringent and less costly to implement, monitor, and enforce.

The Seafood Processing Sector

Overview

Fish processing in the southeastern coastal states from North Carolina to Texas involves several major species and numerous individual products. Southeast fish processing companies serve markets that extend well beyond the region, but the sales of some products are essentially determined by the regional yield, seasonality, and volatility of Southeast fisheries. For the most part, these fisheries are fully developed, and some are considered biologically overfished. To address this, state and Federal fishery management regulations have reduced total allowable catch, brought seasonal and area fishing closures, and allocated catch between recreational and commercial fishermen, all of which may affect the flow of raw material to processors and disrupt their activity for some products.

In some instances, processing companies use imported fish to overcome the effects of regional fishery supply limitations on their viability, growth, and capability to serve and maintain the markets they have developed. An established market, customer base, proprietary brands, and company reputation are valuable intangible assets to a processing business. Specific product availability and price are frequently cited problems for processors, according to surveys of buyers and sellers. Imports may add stability and preclude disappearance of the market for an item, although temporary market gluts (for fresh fish) may result if domestic fisheries are reopened without effective controls on effort.

Table 6-4 lists nine of the most important Southeast Region processed product categories in 1993 (in order of real value): shrimp, farmed catfish, blue crab, menhaden, oysters, freshwater crawfish, spiny lobster, reef fish, and coastal migratory pelagic fish. For each of these categories, the Southeast accounts for much of the U.S. output, though imports may add greatly to the U.S. market supply for some items. For a few items, exports are significant when compared with Southeast production or U.S. market supply. Shrimp, menhaden, farmed catfish, and oysters will be discussed in more detail in subsequent sections.

The total volume and real value of output in southeastern coastal states have trended downward in the past decade, largely reflecting the decreasing volume of menhaden and the declining

Table 6-4
Volume, real value, and real price per pound of processed products in the southeastern United States[1].

Species	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Shrimp										
Volume[2]	253	257	292	264	276	290	312	276	262	269
Real value[3]	$1,065	$991	$1,142	$1,015	$897	$972	$928	$802	$721	$708
Real price[4]	$4.22	$3.85	$3.90	$3.84	$3.25	$3.35	$2.98	$2.90	$2.75	$2.63
Blue crab										
Volume	38	41	39	38	35	32	32	34	31	34
Real value	$118	$113	$113	$112	$101	$99	$100	$85	$84	$95
Real price	$3.09	$2.78	$2.90	$2.93	$2.88	$3.13	$3.17	$2.51	$2.69	$2.78
Oysters										
Volume	26	28	21	18	17	13	12	10	11	13
Real value	$76	$78	$65	$59	$58	$44	$37	$28	$31	$31
Real price	$2.91	$2.82	$3.04	$3.36	$3.39	$3.43	$3.09	$2.84	$2.74	$2.36
Spiny lobster										
Volume	4.7	3.1	3.3	2.5	4.1	2.5	2.8	3.6	2.9	2.5
Real value	$27	$16	$19	$15	$20	$12	$17	$19	$20	$16
Real price	$5.85	$5.15	$5.83	$6.14	$4.87	$4.67	$5.93	$5.40	$6.86	$6.24
Coastal pelagics										
Volume	0.6	1.8	1.3	0.8	1.8	1.7	2.2	2.6	2.1	2.1
Real value	$1	$3	$2	$3	$4	$4	$5	$5	$5	$5
Real price	$2.11	$1.66	$1.62	$3.07	$2.22	$2.10	$2.21	$2.06	$2.39	$2.48
Reef fish										
Volume	1.5	2.1	3.0	2.8	3.2	3.0	3.5	3.7	3.8	3.8
Real value	$7	$9	$15	$16	$15	$14	$16	$16	$15	$16
Real price	$4.86	$4.24	$4.96	$5.52	$4.64	$4.59	$4.61	$4.32	$3.97	$4.16
Crawfish										
Volume	1.6	2.8	4.8	4.4	4.1	9.6	4.6	5.1	8.7	10.3
Real value	$10	$12	$20	$15	$16	$38	$16	$15	$26	$26
Real price	$6.27	$4.09	$4.17	$3.52	$4.04	$3.99	$3.47	$2.92	$3.00	$2.54
Menhaden										
Volume	1,226	1,113	917	1,000	947	903	924	910	674	906
Real value	$189	$141	$132	$157	$166	$119	$108	$110	$90	$105
Real price	$0.15	$0.13	$0.14	$0.16	$0.17	$0.13	$0.12	$0.12	$0.13	$0.12
Catfish										
Volume	82	99	114	147	150	176	183	200	231	233
Real value	$144	$174	$230	$283	$318	$343	$360	$354	$383	$411
Real price	$1.76	$1.75	$2.02	$1.93	$2.13	$1.95	$1.96	$1.77	$1.66	$1.76
Total										
Volume	1,525	1,320	1,406	1,356	1,156	1,086	1,056	1,092	902	1,109
Real value	$1,692	$1,494	$1,674	$1,549	$1,399	$1,409	$1,323	$1,156	$1,085	$1,112
Real price	$1.11	$1.13	$1.19	$1.14	$1.21	$1.30	$1.25	$1.06	$1.20	$1.00

[1]Sources: NMFS data for categories excepting farmed catfish is for production; USDA (1994) data for farmed catfish is for sales. Coastal migratory pelagic fish include king and Spanish mackerel, notably, while reef fish include snappers and groups primarily. The total includes menhaden, but not farmed catfish products.
[2]Volume in million pounds, product weight.
[3]Real value in millions of dollars.
[4]Real price per pound, product weight.

value of shrimp. Even after adding farmed catfish, which experienced significant growth, the total real value dropped nearly 17% during 1984-93 (Table 6-4). In comparison, U.S. value of all seafood increased 8%. It should be noted that production and sales at the processor-wholesaler level in the marketing chain may not be accurately reflected in Table 6-4, as the NMFS Annual Survey of Processors provides data on output, but not sales, inventories or purchases of fish. Also, data on the flow of fish (including some processing) via separate wholesaling companies are not obtained in the NMFS Survey[7].

The number of fish processing plants in southeastern U.S. coastal states was lower in 1993 than 1984 (excluding data for farmed catfish). Employment was also lower, as shown below.

	1984	1993
Average value of output per plant	$2,480,000	$1,890,000
Average monthly employment	17,500	13,472
Seasonal peak in employment	18,147	14,557

Shrimp Processing

Compared with the growth in U.S. consumption of shrimp from 388 million pounds (heads-off) in 1984 to 688 million pounds in 1993, U.S. and Southeast processing plant output has been relatively flat in terms of volume, while real value has declined. The real average "price" (real average unit value) for all Southeast-processed shrimp products declined from $4.22 per pound in 1984 to $2.63 in 1993. The real price of shrimp has exhibited a downward trend since the late 1970's, because world supply has grown faster than world demand, due primarily to farming of shrimp, mostly in countries with suitable sites in tropical climate zones.

Most of the growth in U.S. consumption of shrimp is attributable to three product forms (raw headless, raw peeled, and cooked peeled shrimp), and imports of these products may be marketed to the retail sector with very little value added from processing in the U.S. "Apparent" consumption (market disappearance) is a measure of market size, computed from NMFS published data on U.S. production, foreign trade, and cold-storage holdings, and represents product flow roughly at the processor output level. Actual human intake, household purchases, and household use are measured in special surveys.

The value added in processing is much higher for breaded and canned shrimp than for raw headless, raw peeled and cooked peeled shrimp, but much of the growth in processor-level demand for them appears to have been achieved by the 1970's. When breaded shrimp and other breaded seafood products were introduced shortly after World War II, the use of frozen food was less prevalent than it is today. Seafood markets were also more regional (coastal) in scope, except for a few canned items, notably salmon, sardines, and tuna (in order at that time). Breaded shrimp and other breaded seafood products represented an innovative concept in convenience and portion control for the food service trade; along with counterparts for retail food stores, they added more of a national scope to the market for seafood. Today, even restaurants that are located far inland may offer menu items based on air-transported fresh seafood, or they may use prepared entree, "convenience," custom, and other "value-added" packs from processors; alternatively, some may choose to do their own shrimp breading.

While imports continue to represent a small fraction of the U.S. market for breaded shrimp, the same cannot be said for canned shrimp. There was once much U.S. canning of small shrimp, and the nation was a net exporter (exports exceeded imports) between 1965 and 1981, after which imports exceeded exports. The venerable U.S. canning industry dwindled amidst new competition from Southeast Asian packers, and by the early 1990's the U.S. pack was less than a million pounds, a fraction of what it once was. In the past few years, imports have fallen as well. The fall in imports implies lower U.S. consumption and reduced market demand, given that inventories of canned shrimp did not decrease at the same time. Overall, there has been growth in demand for shrimp, but a gradual shift in preferences from

[7]NMFS. 1994. Unpublished, summarized data from the annual surveys of fish processing plants for 1984-93. U.S. Dep. Commer., Natl. Mar. Fish. Serv., Fish. Stat. Div., Silver Spring, Md.

canned and cured (dried) to fresh and frozen product forms. Therefore, U.S. landings of smaller shrimp are now far more likely to be peeled and frozen rather than peeled and canned. Smaller shrimp comprise a significant proportion of shrimp landed in the Southeast Region; this is especially true of Louisiana landings.

Menhaden Processing

In terms of volume, menhaden is the Southeast's leading species category at the harvesting and processing levels; its main products include fish meal, oil, and solubles. Although these products are sometimes viewed as industrial or inedible in nature, menhaden oil has been mostly exported to Europe for many years for use as a human food ingredient. More recently, such use has been approved for the United States. As with most other oils, there are both edible and inedible uses for menhaden oil. Menhaden fish meal and solubles provide nutritionally high quality ingredients in livestock, fish, and other animal feeds. Depending on international market conditions, the United States may be a net importer or exporter of fish meal. Though the major menhaden processing companies are few in number (possibly suggesting some influence of an oligopolistic market structure on prices), the prices the companies receive for their products are determined in very competitive and complex international markets for numerous meals, fats, and oils, most of which are of agricultural origin.

Because of confidentiality of data, U.S. menhaden data are shown as a whole in Table 6-4. Menhaden is processed mostly in Louisiana, Mississippi, and Virginia, and, to a lesser extent, in North Carolina. There has been some harvesting and processing of menhaden as far north as Canada and the Gulf of Maine, depending on water temperatures and other factors that affect fish availability along the coast (Smith et al.[8, 9]). Viewed over the long term, processor companies have adjusted activity (plants, boats, and fishing effort) in accordance with the cycles in the sizes of the separate Atlantic and Gulf menhaden fish stocks. The Gulf catch has been larger since the early 1960's and was unusually high in most years during 1978-87 because of very good environmental conditions. Gulf landings reached 983,000 t in 1984, but fell to 421,000 t in 1992, and recovered somewhat to 539,000 t by 1993. The Atlantic catch dropped significantly in 1992 as well. The fluctuations in landings are reflected in processor output.

Farmed Catfish Processing

Among the species categories in Table 6-4, the strongest upward trends in processed output in the Southeast are for catfish and crawfish, for which raw material supplies are dependent largely (catfish) or in part (crawfish) on Southeast freshwater fish farming operations rather than harvesting wild fish (USDA, 1994). Freshwater catfish are farmed and processed largely in inland areas of southeastern coastal states. Using national totals, processor sales of pond-raised catfish have grown sharply, from 2.8 million pounds in 1970 to 27.8 million pounds in 1980, 183 million pounds in 1990, and 233 million pounds in 1993 (USDA, 1988, 1994). In 1993, the real value of processor sales was $411 million, putting catfish second only to shrimp in terms of value of sales. The growth in sales exceeds that for most fisheries, partly because of the lack of resource constraints with wild fish stocks. Also, aquaculture operations can provide year-round supplies, and specific quality and appearance attributes that may not be possible with wild fish. Of course, fish farming is not without problems. Import competition was once a concern, but imports have been on a downward trend from a peak of 18 million pounds in 1978 to about 4 million pounds in 1993, and the industry is exploring the potential for increasing its yet small exports. Among other concerns, there will always be the need to keep costs competitive, and increasingly stringent effluent standards will require methods of reducing waste discharge from aquaculture operations.

[8]Smith, J. W., and Menhaden Team. 1994a. Status of the menhaden fisheries: a report to the National Fish Meal and Oil Association, San Diego, California, November 1994. U.S. Dep. Commer., Natl. Mar. Fish. Serv., Beaufort, N.C.

[9]Smith, J. W., and Menhaden Team. 1994b. Preliminary forecast for the 1995 Gulf and Atlantic menhaden purse-seine fisheries and review of the 1994 fishing season. U.S. Dep. Commer., Natl. Mar. Fish. Serv., Beaufort, N.C., Dec.

Table 6-5
Real value and volume of shrimp imported to the U.S., by country of origin.

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Thailand										
Value[1]	56	63	62	64	88	172	221	367	434	565
Volume[2]	8	11	11	11	11	22	25	45	54	67
Ecuador										
Value	204	176	287	378	368	284	257	308	313	298
Volume	21	20	28	46	47	37	38	49	55	49
Mexico										
Value	410	314	342	401	299	263	156	154	121	170
Volume	37	31	34	39	29	27	17	17	14	20
China										
Value	14	23	65	119	289	255	314	186	263	148
Volume	1	3	9	19	47	47	57	35	49	31
Indonesia										
Value	9	6	8	12	17	48	66	90	101	89
Volume	1	1	1	2	2	6	9	12	14	13
India										
Value	45	45	48	57	53	48	50	57	50	66
Volume	10	11	11	13	15	13	14	18	18	19
Bangladesh										
Value	13	14	20	32	49	42	50	31	56	64
Volume	1	2	3	4	5	6	7	5	8	10
Honduras										
Value	19	19	26	28	31	23	25	36	44	54
Volume	2	2	3	4	4	3	4	6	8	10
Panama										
Value	68	72	80	70	55	63	36	40	40	41
Volume	7	9	10	8	7	8	5	6	5	6
Brazil										
Value	67	72	68	51	57	38	19	20	29	23
Volume	9	11	9	8	9	8	4	4	6	4
Colombia										
Value	20	14	19	20	18	24	28	31	20	21
Volume	2	2	2	2	2	3	4	5	3	3
Philippines										
Value	10	21	21	26	36	52	38	49	33	20
Volume	1	2	2	3	3	6	5	6	4	3
Others										
Value	402	382	435	452	329	260	205	207	165	187
Volume	55	58	59	58	48	42	38	37	32	38
Total										
Value	1,337	1,221	1,481	1,710	1,689	1,572	1,465	1,576	1,669	1,746
Volume	155	163	182	217	229	228	227	245	270	273

[1]Real value is given in millions of dollars.
[2]Volume is given in thousands of metric tons.

Oyster Processing

Although there is some element of aquaculture (or at least enhanced natural production) associated with the oyster fishery, the strongest downward trend evident in Table 6-4 is for this species, and it appears to be related to a complicated set of factors concerning resource abundance and market demand. Southeast oyster landings were relatively high in 1984-85 and they recovered more in the early 1990's than is suggested by the processing sector data in Table 6-4. It is possible that this difference in trends could be explained by the shipment of shellstock (sacks of live oysters) out of the Southeast Region to the Chesapeake Bay for shucking, or to the fact that more live oysters are being marketed directly to consumers. U.S. landings of Eastern oysters were substantially lower in 1993 than in 1984 because of a sharp drop in landings in the Chesapeake Bay, where two recurring oyster diseases, MSX and *Dermo*, reached proportions great enough to reduce significantly the stock of living oysters. However, total U.S. landings of oysters have been declining for decades.

Currently, Southeastern U.S. resource conditions are thought to be relatively good, but there is concern within the trade about market demand (McAvoy[10]), which has been affected by publicity about possible effects of consuming raw oysters. There are requirements by some states that sacks of shellstock have warning labels about the virus *Vibrio vulnificus* and that restaurant or "raw bar" menus have similar warnings. Serious human illness can occur in individuals with compromised immune systems if *Vibrio* is ingested with raw oysters. Reportedly, there are some 15 deaths a year in the United States from this virus. More prevalent and far less serious incidences of human illness can be traced to the ingestion of raw oysters from waters contaminated by fecal coliform and Norwalk bacteria, but tests are available only for the former. The presence of fecal coliform bacteria has long been a primary indicator in the classification of molluscan shellfish-growing waters for harvesting, including their closure as necessary, by state health agencies in accord with the National Shellfish Sanitation Program's guidelines. The industry is currently exploring new tech-

[10]McAvoy, H. 1995. Fla. Dep. Agric., Fla. Bur. Seafood Market., Wilder Off. Cent., 3000 Gulf to Bay Blvd., Suite 402, Clearwater, FL 34619. Personal commun.

niques, such as depuration and irradiation, which may have implications for its variable costs.

The Seafood Trade Sector

Important Species in the Southeast Region

Shrimp: Shrimp is one of the most popular seafoods in the United States. Over the last 10 years, consumption has risen from 2.5 pounds per capita in 1984 to a record high of 3.3 pounds per capita in 1993. Increasing world supplies, largely due to burgeoning shrimp culture, have made shrimp plentiful and helped keep prices low. In fact, in real dollars, shrimp is 23% cheaper per pound in 1993 than it was in 1984. Imports of all forms of shrimp by the United States, the world's biggest shrimp market, have fluctuated in value between $1.2 and $1.7 billion (in 1993) over the 10-year period 1984-93 (Table 6-5).

The volume of imported shrimp has steadily grown over the 10-year period, reaching a record 273,000 metric tons (t) in 1993, four times as great as domestic shrimp landings. Of the two predominant categories of imported shrimp, "raw headless shrimp" imports have been declining while "raw peeled shrimp" imports have been increasing.

Thailand, Ecuador, Mexico, China, and Indonesia were the five major suppliers (in terms of value) in 1993 (Fig. 6-7, 6-8). Notably, all but Mexico are major shrimp culturing countries. Thailand's rise to the top over the last 10 years has been dramatic. The value of shrimp imports from there rose from a mere $56 million in 1984 to $565 million in 1993. Most of Thailand's production is farmed black tiger shrimp.

Ecuador is a pioneer in the shrimp farming business and was producing substantial quantities of cultured shrimp as early as 1984, when U.S. imports of Ecuadorian shrimp were worth $204 million. The 1993 imports, valued at $298 million, were mostly western white shrimp.

Mexico fell from being the leading U.S. supplier in 1984 to third place in 1993, with imports worth $170 million. Mexico, which is dependent on wild-caught stocks, had poor seasons in 1990 through 1992 that depressed U.S. imports. Speculation on reasons for the decline in production include climatic factors, pollution, and overfishing in the estuaries. However, a rebound took place in 1993, a result of good seasons on both coasts and possibly the privatization of the shrimp industry (from the previous cooperative system).

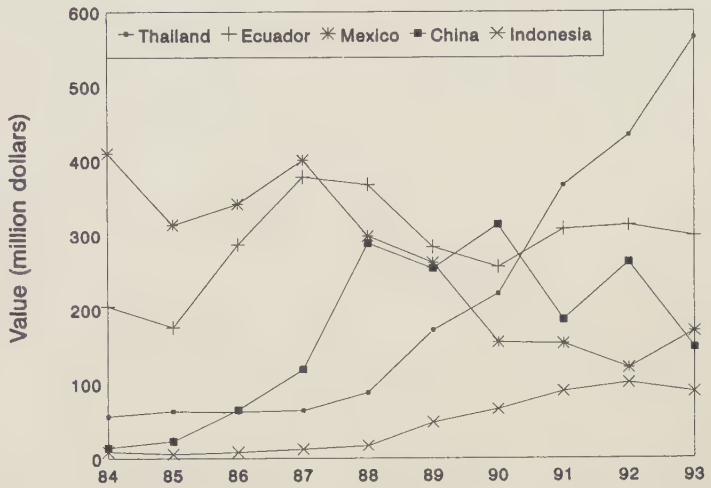


Figure 6-7
Real value of shrimp imports to the Southeast by leading suppliers.

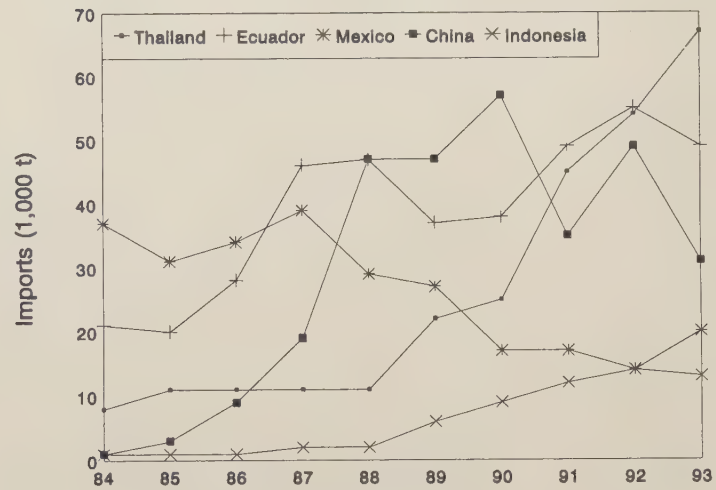


Figure 6-8
Volume of shrimp imports to the Southeast by leading suppliers.

Table 6-6
Southeastern U.S. imports[1] of snapper.

	Imports			Percent
	1991	1992	1993	change
Fresh				
Value	13,608	15,687	15,745	16
Volume	4,895	5,546	6,336	29
Frozen				
Value	1,860	2,337	2,193	18
Volume	761	1,073	956	26
Total				
Value	15,468	18,024	17,938	16
Volume	5,656	6,619	7,292	29

[1]Values are given in thousands of dollars and volume is given in metric tons.

Table 6-7
Southeastern U.S. imports[1] of grouper.

	Imports			Percent
	1991	1992	1993	change
Fresh				
Value	5,187	7,484	7,557	46
Volume	2,527	3,250	3,141	24
Frozen				
Value	3,239	1,486	957	-70
Volume	1,756	686	480	-73
Total				
Value	8,426	8,970	8,514	1
Volume	4,283	3,936	3,621	-15

[1]Values are given in thousands of dollars and volume is given in metric tons.

China, which has the only major shrimp culture industry in temperate latitudes, accounted for imports valued at $148 million in 1993, compared to only $14 million in 1984. The cultured shrimp called "China whites" are virtually indistinguishable from the white shrimp produced in the Gulf and South Atlantic. Heavy flooding hit the shrimp farming regions in 1991, reducing production and U.S. imports significantly that year. In 1993, a different disaster hit China's shrimp farms in the form of disease that wiped out many of the shrimp, causing exports to the U.S. to fall precipitously.

Indonesia's dramatic rise to status as a major shrimp producer and exporter is another aquaculture success story. The culturing of mostly black tiger shrimp accounts for U.S. imports exploding from $9 million in 1984 to $89 million in 1993.

Snapper: Imports of all snapper reached a total value of $17.9 million in 1993, up 16% over the 1991 value (Table 6-6). Fresh snapper constituted 88% of the total imports (by value) of snapper, while frozen products made up the rest. The value of fresh snapper imports reached $15.7 million in 1993, an increase of 16% over 1991. The top five sources of fresh snapper, by value, for all three years were Mexico, Panama, Costa Rica, Venezuela, and Nicaragua. Mexico, the leading supplier, accounted for 26% of fresh U.S. imports by value in 1992.

Frozen snapper imports also increased. The 1993 total of $ 2.2 million topped the 1991 total by 18%. The top 1993 suppliers of frozen imports, in order of value, were Thailand, Mexico, Taiwan, India, and Japan. Thailand accounted for 21% of the imports by value.

The Gulf of Mexico was closed to U.S. commercial red snapper fishing for about 4 months in 1991, 9 months in 1992, and again for 9 months in 1993 for management purposes. This put pressure on U.S. wholesalers to obtain sources of imported snapper, especially to supply those restaurants that carry snapper on their menus.

Grouper: U.S. demand for fresh grouper continues to exceed domestic production, requiring imports of fresh product from Latin American countries. Total grouper imports reached $8.5 million in 1993, up 1% over 1991 (Table 6-7). Fresh grouper comprised 89% of the total imports (by value) in 1993, while frozen made up the rest. The total value of fresh grouper imports reached $7.6 million for 1993, an increase of 46% over the 1991 level.

The top foreign suppliers of fresh grouper for all 3 years, by value, were Mexico, Panama, Costa Rica, Columbia, and Ecuador. Mexico was by far the top supplier, accounting for 48% of the fresh imports in 1993 (by value). However, this was a drop in import market share compared to the 1992 share of 61%, attributable to an increased domestic (Mexican) market. Reportedly, the price offered in Mexico City for grouper is frequently equal to or higher than that offered by U.S. importers. The growing Mexican market stems from greater use by the wealthier socioeconomic classes and the burgeoning tourist industry.

Frozen grouper imports declined dramatically from 1991 levels, down 70% in 1993. The top suppliers in 1993 were Taiwan, Japan, Mexico, India, and Thailand. The leader, Thailand, accounted for 21% of the frozen imports in 1993. Grouper is increasingly being sold fresh instead of frozen to

Table 6-8
Southeastern U.S. exports[1] of mullet roe.

	Imports		Percent
	1992	1993	change
Fresh			
Value	132	837	534
Volume	13	73	462
Frozen			
Value	8,678	11,336	31
Volume	746	758	2
Total			
Value	8,810	12,173	38
Volume	759	831	9

[1]Values are given in thousands of dollars and volume is given in metric tons.

capitalize on the premium prices that the fresh product attracts.

Mullet Roe: The southeastern United States is the major mullet roe producing area of the world. Mullet roe exports rose in 1993 to 831 (t), valued at $12.2 million, a 38% increase in value (Table 6-8). The great majority of the exports were frozen. Taiwan accounted for 93% of the foreign market, despite a 17.5% tariff. Italy and France comprise the remainder of the market. Mullet roe is a delicacy in the Orient; the peak demand occurs just before the Chinese New Year, when it is a traditional item for personal consumption and gift giving. A small portion of the mullet roe reaches Japan after being processed in Taiwan.

Fresh mullet roe exports, although small when compared to frozen roe exports, showed a dramatic increase. According to industry sources, most of the fresh product is actually "male roe" or testes. This appears to be a rapidly developing market, aided by the advent of more direct airline connections for airfreighting.

Sponges: U.S. sponge exports totaled $2.3 million in 1993 (Table 6-9). This represents a decline of 33% (by value) from 1989 (the first year export data for sponges were collected). Greece was the foreign market leader in 1993, representing 15% of the export market. Other primary foreign markets were Germany, the United Kingdom, Italy, and France. According to sponge wholesalers, about half the market for sponges is overseas and half is domestic. The major change in the industry since 1989 is the fall of Hong Kong as a major market. According to industry sources, Hong Kong switched to other sources of sponges in Cuba and the Bahamas. Exports to Europe, however, increased during the period. Sponge industry leaders believe that exports to Europe could be substantially increased if the 8% European Community tariff were removed.

Table 6-9
Southeastern U.S. exports[1] of dried sponges.

	Imports					Percent
	1989	1990	1991	1992	1993	change
Exports						
Value	3,403	4,712	3,415	2,381	2,275	-33
Volume	171	148	108	142	131	-23

[1]Values are given in thousands of dollars and volume is given in metric tons.

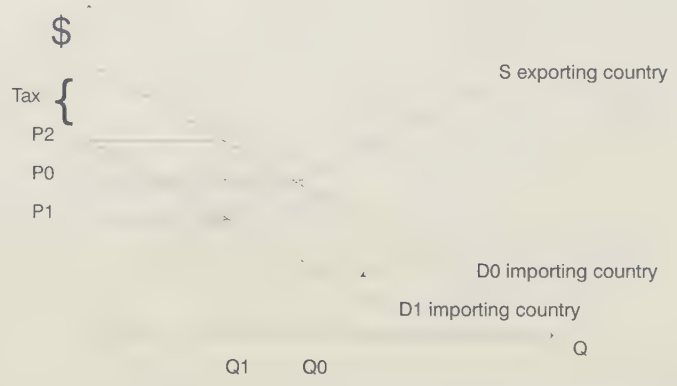
Florida is the only sponge producing state; it established itself as the major supplier of sponges in the world beginning in 1986, when the Mediterranean sponge blight depleted sponges from that important sponge producing area. Sponging primarily occurs in the Florida Keys and along Florida's west coast; Tarpon Springs is the processing and marketing center.

Sponges have a wide variety of manufacturing and medical applications as well as the better known home cleaning uses. The mainstays of the industry are the highly valuable wool sponge and the more common yellow sponge. Sponges have the special ability to regenerate themselves from the stub that remains after harvesting and may be "farmed" by attaching sponge pieces to the bottom.

The Effects of NAFTA on Southeast Region Trade with Mexico

The North American Free Trade Agreement (NAFTA) was implemented on January 1, 1994. It is expected to have a significant effect on the United States' fishery product trade with Canada and Mexico, the cosignatories. In 1993, the U.S. exported $409 million worth of edible fishery products to Canada while importing Canadian product valued at $1,080 million. Exports to Mexico totaled $53 million in 1993, while imports from there were valued at $292 million.

NAFTA may have a more significant impact on trade with Mexico than on trade with Canada because of the preexisting U.S.-Canadian Free Trade Agreement. For this reason and due to geographical proximity, there is special interest in the Southeast Region in the effects of NAFTA on trade with Mexico.



NAFTA: A unit tax shifts the effective demand for a good from D0 to D1. Equilibrium price and quantity are reduced to P1 and Q1 when the tax is imposed. At quantity Q1, however, consumers pay price P2 (P1 + the tax) while producers receive price P1. The difference is collected by the taxing government for each unit of production up to Q1. The net benefits lost by both consumers and producers are greater than the net benefits gained by the government in tax revenues, so the tax results in a net loss to society.

In 1986, Mexico unilaterally began to reduce its tariffs on fishery products from an average tariff of 50% to 20%. This was done in conjunction with Mexico's accession to the GATT (General Agreement on Tariffs and Trade). With the implementation of NAFTA, Mexican tariffs are being reduced further, many of them immediately, some gradually over 5 or 10 years. These tariff reductions will open up new markets in Mexico to U.S. exporters, as U.S. products become more competitive with Mexican products and similar products entering Mexico from other countries (which are still subject to Mexico's tariffs). Increased demand for U.S. fishery products may also occur due to rising incomes in Mexico, attributable at least in part to the benefits of NAFTA.

Exports of some southeastern U.S. products to Mexico had already begun to increase pre-NAFTA and should accelerate with NAFTA. Large Mexican cities and resorts such as Acapulco and Cancun have been, and increasingly will be, taking advantage of good airline connections to Miami and other southern airports for a dependable supply of high quality fresh and frozen seafood, such as spiny lobster, snapper, and swordfish. Less expensive southeastern U.S. seafood such as mullet, Spanish mackerel, and shark will also find an increasing market in Mexico, according to traders. Companies in the Southeast Region will also export products originating in other regions such as squid, snow crab, and breaded fish portions. Markets may develop for products new to Mexico such as farmed catfish. It is conceivable that even shrimp products will be exported to Mexico, destined for buyers who want, for example, shrimp with special breading not produced in Mexico. This trade will occur in much the same way that Florida shrimp is sold in Louisiana, even though Louisiana is a shrimp producer (and vice-versa). NAFTA is eliminating the requirements to transfer trucked cargo to Mexican carriers at the border, which will enable seafood to be picked up anywhere in the United States and delivered anywhere in Mexico.

Imports from Mexico are not expected to increase dramatically as a result of NAFTA. U.S. tariffs were not a major barrier to trade, since they were low to begin with, usually only a few percent or duty free. For example, shrimp in all forms enters the United States duty free and is subject only to the requirements of the U.S. Food and Drug Administration.

NAFTA liberalizes Mexican regulations that previously limited U.S. (and Canadian) investment and ownership in Mexican companies to 49%, including fishing, seafood processing, and aquaculture sectors. This could potentially provide U.S. and Canadian capital for increased Mexican seafood production and processing, thus increasing the potential for greater Mexican exports to the United States as well as to other countries.

Will U.S. seafood processors relocate to Mexico? The only impetus NAFTA provides is the aforementioned investment/ownership liberalization. "Cheap" labor existed even before NAFTA was implemented. Factors that favor continued U.S.-based processing are close proximity to raw products and markets and superior infrastructure. Thus, relocations are expected to be minimal. Overall, it appears likely that U.S. trade with Mexico will be stimulated in both directions, thus fulfilling the goals of NAFTA.

The Recreational Harvest Sector

Regional Management Issues

In general, management of the southeastern recreational fisheries is typically driven by biological concerns related to overfished stocks and specific recovery plans. These plans define the total allowable catch (TAC) for the entire fishery, a portion of which is then assigned to both the commercial and recreational sectors in the form of a quota or allocation. Once the recreational allocation is determined, the usual approach is to determine the combination of bag, size, and season limits that is capable of restraining catch to that allocation. Additional implicit suballocations among the various factions within the recreational fishery (private angler vs. for-hire sector, etc.) may then exist through the use of differential size, bag, or seasonal restrictions.

Economics can play a role in the establishment of and change in fishery management measures, as implementation or adjustment of any regulatory measure requires consideration of the resultant impacts on the participants in the fishery. A common concern is how stocks are allocated. The TAC has traditionally been allocated between the commercial and recreational sectors according to historical catch percentages. However, economic theory dictates that scarce resources be allocated to their highest valued uses and historical-based allocations are appropriate only if they truly reflect the value placed on the resource by the various sectors. An example of another issue is the impact of more restrictive bag and size limits. Economic theory would argue that the short-term loss in angler consumer surplus from fewer or less productive trips as a result of a more restrictive fishing environment is justified only if it is exceeded by the benefits of achieving recovered stocks or fisheries.

Answering these questions requires determining the value placed on the resources by the various user groups and examining how these values change. Recreational value takes the form of angler consumer surplus and is often less readily calculated than commercial producer surplus. Few studies exist on the recreational fisheries of the Southeast upon which to demonstrate these changes in value. Thus, economic discussions of the impacts of specific management changes in southeastern recreational fisheries are often limited to theoretical or intuitive descriptions.

A current problem facing management in both the South Atlantic and the Gulf of Mexico subregions is the reliance upon size and bag limits to control catch. Unless bag and size limits are especially severe, catch is likely to exceed targets as these regulations place little restraint on overall effort. Catch performance in a fishery is a function of effort, stock abundance, and catch frequency (the percentage of trips that catch 1, 2, 3, ... fish). These factors are interrelated in a dynamic fashion, each influencing the others. For example, larger stocks produce higher catch frequencies that may attract greater effort into the fishery. If any of these factors are underestimated, catch overruns can occur. Effective management must consider these relationships and account for the impacts of management on angler effort.

Failure to control effort has additional relevance given the current climate to restrict commercial netting operations. Florida recently restricted gill and entangling net activity in state waters, joining the ranks of Texas, Georgia, and South Carolina. Other states are considering similar action to improve the health of the fisheries in their respective waters and out of concern over an influx of displaced netters from Florida. Any biological gains to the stocks of recreational species as a result of such controls may be brief and fleeting, however, as increased effort is applied using other gear types to harvest those fish spared the nets. Simply restricting net use is not a sufficient means of replenishing stocks. Additional controls are required to save the fish and their progeny from anglers on a continuing basis, and this requires controlling catch or effort.

The Gulf of Mexico red snapper recreational fishery provides evidence of the sometimes confounding nature of fisheries management. As stocks improve, it may be necessary to impose increasingly restrictive catch limits to maintain recovery schedules. Recovery schedules typically specify the amount of fish (in pounds) that can be annually harvested from a fishery. As a stock improves, it becomes easier to harvest these fish. Allocations are met sooner. The lack of controls on recreational effort and absence of closure exacerbates the situation and the net effect is that allocations are exceeded, sometimes grossly, as seen in the red snapper fishery. In the absence of closure or effort controls, managers are forced to attempt to control catch through larger minimum sizes and lower bag limits, producing the seemingly per-

verse situation where anglers are allowed to keep fewer fish as they become more abundant.

Finally, management of some Southeast fisheries is complicated by the migratory nature of species. For example, king mackerel catch is controlled in the Southeast by the comanagement of the species by both the South Atlantic and Gulf of Mexico Fishery Management Councils. While the issue of genetic distinction is still unresolved, king mackerel exist in distinct Atlantic and Gulf migratory groups, of which members of the Gulf group migrate into South Atlantic waters during certain times of the year. Quotas are set and managed by migratory group, and the effect of the migrations is that catch in certain months by anglers in some Atlantic coast Florida counties counts towards the Gulf migratory group quota. In other months, catch from the same location counts towards the Atlantic migratory group.

A potential problem resulting from this is that as the fish migrate from one subregion to another, it is possible for anglers in one subregion to catch the quota before anglers in the other subregion have access to the fish. While this is a potential problem with any migratory species, the concern is valid for the mackerel fishery only to the degree that anglers in one subregion deplete the resource, thereby negatively impacting catchability in another subregion, as recreational closure is currently not allowed. Consideration is nevertheless being given by one Council to fix the geographic boundary at one side of Monroe County (the southernmost Florida county) to simplify management. This would result in catch being credited to the subregion in which it occurred regardless of migratory group. Such a realignment has economic implications only if it results in a reallocation of quota from anglers in one subregion to anglers in another subregion and valuation of the resource varies by user group.

Further, this is of concern only if management in one subregion impacts the ability to harvest fish in another. In the absence of closure in the Gulf when the quota is met, no guarantee that Gulf group king mackerel will reach the South Atlantic can be made. Hence, adjusting the regulatory boundaries changes nothing regarding guaranteed access to fish. Original allocations and quotas were made based on biological and not economic concerns and adjusting the regulatory boundary does not alter this arrangement.

Management of South Atlantic Recreational Fisheries

Federally managed species in the South Atlantic[11] are managed through various combinations of size limits, bag limits, permits, quotas, and closed seasons. For example, red drum, striped bass, Nassau grouper, and jewfish are closed to harvest or possession in or from Federally managed waters. Of the other managed fisheries, only two, spiny lobster and summer flounder, currently have seasonal closures.

Current and potential recreational management issues in the South Atlantic include liberalization of the spiny lobster harvest restrictions in areas north of Florida, additional controls on the sale of recreational catch, and reallocation of the Atlantic group Spanish mackerel. A recently passed amendment to the Fishery Management Plan (SAFMC and GMFMC, 1994) for spiny lobster allows a year-round bag limit of two lobsters per person per day in waters north of the Florida-Georgia border. No clearly defined recreational lobster fishery of any consequence exists in these waters. Recreational harvesters currently harvest a small number of spiny lobsters when the season is officially closed. This harvest occurs relatively unencumbered due to an absence of enforcement, a situation reflective of the small stock size, the absence of demonstrated biological significance, and the lack of importance of the fishery relative to others in the area. Thus, there has been no demonstration of lost economic benefits providing the motivation for the amendment; individuals who were aware of the resource and wished to harvest it have done so. Nonetheless, the amendment process moved forward, resulting in regulatory and administrative expenditures that may actually exceed the value of the fishery.

Except for the prohibition of sale of all recreationally caught billfish, Warsaw grouper, and speckled hind, the sale of other species is allowed in the South Atlantic recreational fishery subject to various state regulations. The imposi-

[11]Federally managed species in the South Atlantic recreational fishery include the pelagic species (bluefish, cobia, king and Spanish mackerel, bluefin, bigeye and yellowfin tuna, various sharks, and billfish), and several species in the reef fish complex, including vermillion, red, yellowtail and other snappers, black, gag, red and other groupers, black seabass, red porgy, and greater amberjack. Additionally, red drum, striped bass, spiny lobster, and summer flounder are regulated species.

tion of additional Federal controls on such activity was expected to be discussed by the SAFMC in 1995, but no specific limitations were then being processed. The economic rationale behind prohibiting sales of recreational catch is that: 1) harvest pressure is reduced through the elimination of the sales incentive to fish; 2) commercial closures are not accelerated due to recreational sales counting towards the commercial quota; and 3) monitoring and enforcement costs are reduced as the distinction between commercial and recreational effort becomes more clearly defined.

In the Spanish mackerel fishery, the current commercial:recreational allocation is 50:50. In recent years, however, the recreational sector has not harvested its quota, and an increase in the commercial allocation is being considered. From an economic perspective, such a reallocation must consider whether the recreational sector's failure to harvest the quota is due to circumstance or design (cannot harvest vs. do not care to harvest), and must additionally consider the impacts of additional commercial quantities on industry profitability. Typically, a reallocation is justified if the gain in surplus by one sector (commercial) exceeds that lost by the other sector (recreational). Currently, however, no evidence exists to suggest that the recreational sector is precluded from catching their allocation of Spanish mackerel and, hence, no loss in consumer surplus would be expected in the recreational sector should reallocation occur.

Management of Gulf of Mexico Recreational Fisheries

As in the South Atlantic, federal management of recreational species in the Gulf of Mexico[12] is done through various combinations of size limits, bag limits, and closed seasons. For example, red drum and jewfish are closed to harvest or possession in or from Federally managed waters. Of the other managed species, only the stone crab and spiny lobster fisheries have programmed seasonal closures, although the bluefin tuna fishery is subject to closure upon meeting the quota.

Current recreational management issues include reduced bag limits and increased minimum size requirements for red snapper due to recent harvest overruns. The recreational fishery exceeded its quota by 93% in 1992 and 88% in 1993. The Gulf of Mexico Fishery Management Council (GMFMC, 1994) approved a reduction in the bag limit from 7 fish to 5 fish, and an increase in the minimum legal size from 14 inches total length to 15 inches. These changes are motivated by a desire to accomplish the biological goals of stock recovery. Although economic considerations are important in determining the proper mix of management adjustments, inadequate knowledge of the impacts of specific management changes precludes precise analysis. Of specific importance is the impact of management changes on the number of trips demanded and the resultant change in net economic benefits. These effects are currently being examined for Gulf of Mexico reef fish by researchers at the University of Florida, but results are as yet unavailable.

These relationships have been studied for Gulf of Mexico group king mackerel. Using 1990 and 1991 Marine Recreational Fisheries Statistics Survey data, Milon[13] found no statistical support for a positive relationship between king mackerel catch rates and days fished. Milon further suggested that king mackerel bag limits may have contributed to increased catch rates and increases in king mackerel target effort. This is not wholly inconsistent with logic in that limiting individual catch should both allow stock improvement and increase the availability of fish for other anglers, thereby increasing individual catch rates and attracting effort. Additionally, the very existence of the regulations may produce the perception that the stocks are being better managed, thus attracting additional effort. Nevertheless, few studies currently exist on which to base estimates of the change in recreational benefits resulting from various management measures.

[12]Federally managed species in the Gulf of Mexico recreational fishery include pelagic species (e.g., cobia, king and Spanish mackerel, various billfish, tuna and sharks), and several species in the reef fish complex including red, vermillion, lane and other snappers, black, red, gag and other groupers, black seabass, jewfish and greater amberjack. Additionally, red drum, stone crabs, spiny lobster and coastal sharks are regulated.

[13]Milon, J. W. 1993. A study of recreational demand for Gulf of Mexico group king mackerel using 1990 and 1991 MRFSS data. Final Rep. Prep. for Gulf Mex. Fish. Manage. Counc., Tampa, Fla.

Summary Statistics

Figures 6-9—6-15 and Table 6-10 provide summary statistics on effort and catch in the southeastern U.S. recreational fishery for 1983-93. Figure 6-9 shows total participants by subregion. Its most notable feature is the shift in dominance in recent years of total South Atlantic participants over total Gulf of Mexico participants. Total trips have been roughly equal in both areas. Figure 6-10 depicts the cyclical nature of total trips by subregion, a phenomenon more clearly seen in Figures 6-11 and 6-12 which additionally depict total trips by mode. Total trips peak in 1985, 1988, and 1991, or every 3 years, in both subregions. Both subregions also show a downward trend in total trips. Shore fishing dominates effort in the South Atlantic. Private/rental boat fishing holds the edge in the Gulf of Mexico, though the lead is less distinct than that seen in the South Atlantic. Total charter trips have been relatively stable in both subregions since 1987, while total shore and private/rental boat trips have followed cyclical patterns.

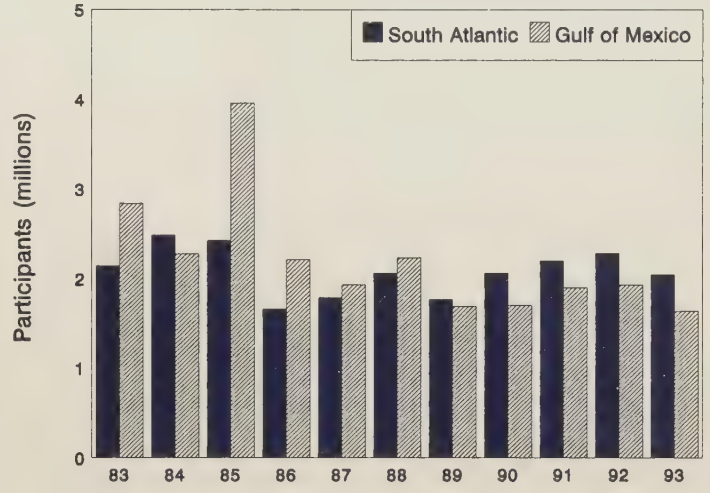


Figure 6-9
Number of participants, Southeast recreational fishery, 1983-93.

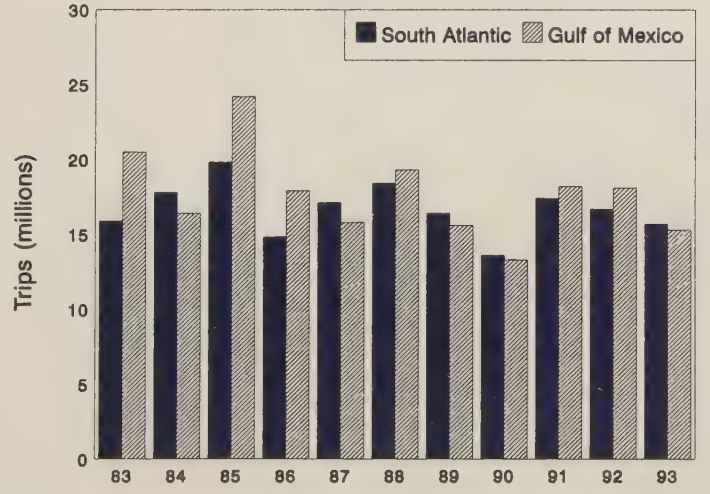


Figure 6-10
Number of trips, Southeast recreational fishery, 1983-93.

Table 6-10
Top five species caught (in millions of fish) in the southeastern United States in 1983 and 1993 by subregion.

	South Atlantic			
	1983		1993	
Rank	Species	Catch	Species	Catch
1	Bluefish	10.0	Spot	5.2
2	Spot	8.8	Bluefish	2.8
3	Black sea bass	5.0	False pilchard	2.8
4	Atlantic croaker	4.4	Pinfish	2.7
5	Saltwater catfish	3.0	Atlantic croaker	2.7

	Gulf of Mexico			
	1983		1993	
Rank	Species	Catch	Species	Catch
1	Saltwater catfish	20.4	Scaled sardine	20.2
2	Spotted seatrout	14.1	Spotted seatrout	16.5
3	Atlantic croaker	11.6	Hardhead catfish	7.7
4	Herrings	8.2	Red drum	5.5
5	Sand seatrout	5.0	White grunt	4.1

Figure 6-13 shows total southeastern U.S. catch by subregion. The most remarkable point is the dominance of Gulf of Mexico catch over that of the South Atlantic. Since 1988, total catch in the Gulf of Mexico has been 2-3 times that of the South Atlantic. Further, while total catch in both subregions shows the same cyclical patterns as total effort, total catch has shown a downward trend in the South Atlantic and an upward trend in the Gulf of Mexico. Average catch per trip has remained stable at approximately three fish per trip since 1987 in the South Atlantic, while catch in the Gulf of Mexico has increased, from six fish per trip in 1987 to over eight fish per trip in 1993. Performance in the South Atlantic might suggest stable stocks, while the improving performance in the Gulf of Mexico could suggest improved stocks or increased awareness of exploitable species. Such determinations, however, would require examinations of the species composition of catch as, despite the appearance of stability or improvement, certain species may in fact be in decline while other more accessible but less desirable species are substituted.

Table 6-10 addresses this last issue somewhat by showing a comparison of the top five species in terms of number of fish caught in 1983 and 1993 for both subregions. The South Atlantic showed more stability with three species (bluefish, spot, and Atlantic croaker) remaining in the top five over the time period, but each of the three species experienced a 39% or greater decline in catch. This would suggest that anglers are targeting the same species, but declining stocks make the stocks less accessible. In the Gulf of Mexico, only saltwater catfish and spotted seatrout retained their top five rankings. Although catfish catch declined, spotted seatrout catch increased despite declines in total trips, suggesting a shift in targeting behavior. Shifts in target activity are further evidenced by the presence of scaled sardine, a baitfish, as the dominant species in the Gulf of Mexico in 1993. The implications of these target shifts is that they demonstrate the increasingly adaptive ability of anglers to specialize and target specific species. Anglers are better able to selectively target individual species and are thus less subject to random catch. Fisheries management must acknowledge this and respond with rules that simultaneously address the species of concern as well as the potential repercussions in other related species.

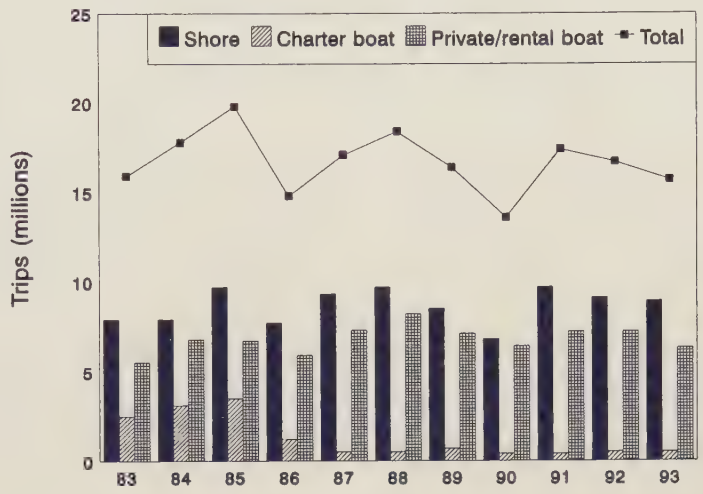


Figure 6-11
Number of trips by mode, South Atlantic recreational fishery, 1983-93.

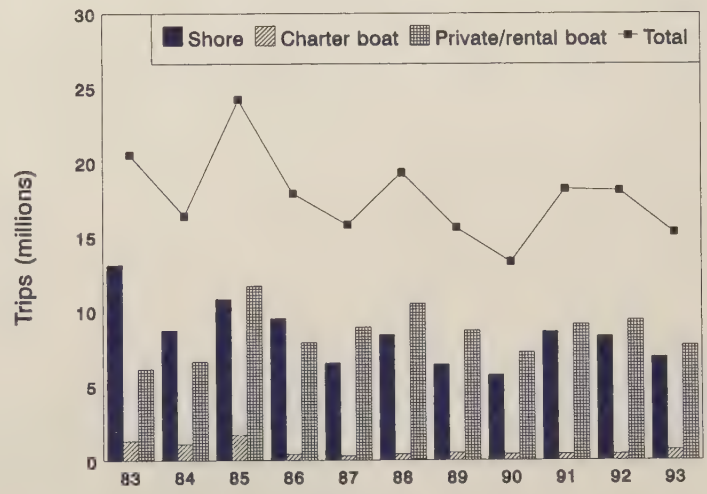


Figure 6-12
Number of trips by mode, Gulf of Mexico recreational fishery, 1983-93.

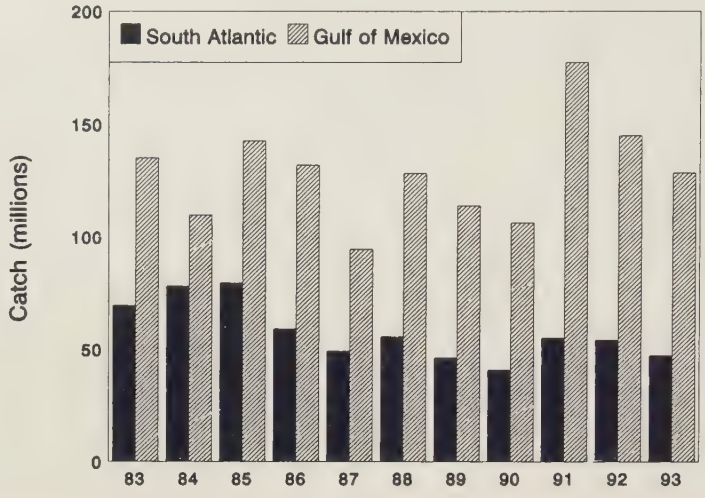


Figure 6-13
Total catch, Southeast recreational fishery, 1983-93.

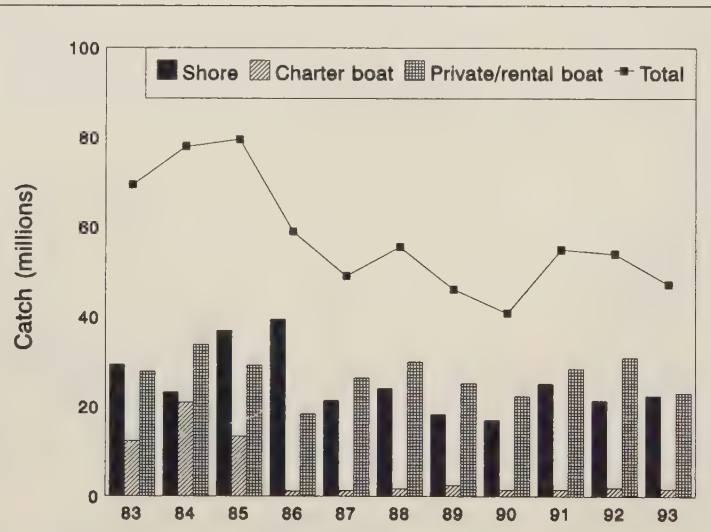


Figure 6-14
Total catch by mode, South Atlantic recreational fishery, 1983-93.

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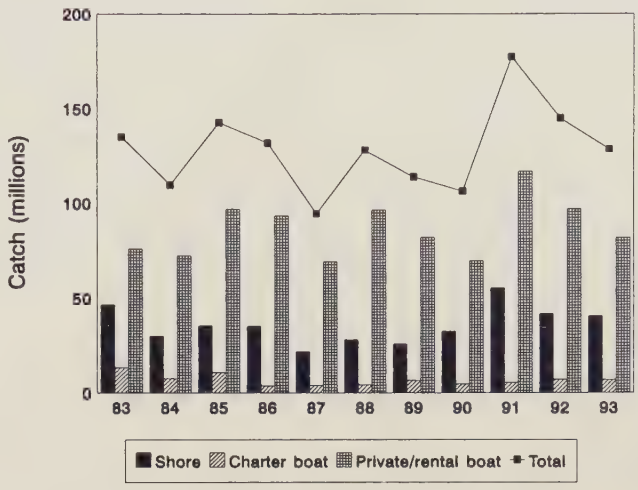

Figure 6-15
Total catch by mode, Gulf of Mexico recreational fishery, 1983-93.

Southeast Spotlight Article

Economic Interactions Between the Shrimp and Red Snapper Fisheries in the U.S. Gulf of Mexico

One of the more challenging fishery management and economic issues in the Southeast Region concerns the incidental bycatch of juvenile red snapper by shrimp trawlers in the U.S. Gulf of Mexico. Significant quantities of a large variety of finfishes are caught routinely as incidental bycatch during the course of shrimp trawling (Nichols and Pellegrin[1]). While some of the bycatch has market value, most of it has little or no value and is discarded to make room for the more valuable shrimp.[2] Further, most of the discarded finfish are killed in the landing, culling, and discard process. Juvenile red snapper constitute one of the most important species discarded.

The incidental bycatch of juvenile red snapper has become a serious problem for fishery managers because it contributes significantly to the depleted status of the red snapper resource in the Gulf of Mexico. It has been estimated that less than 20% of each year class of juvenile red snappers survive the period of exposure to the shrimp fishery, and that the red snapper stocks cannot recover unless the mortality from shrimp trawling can be reduced by at least 50% (Goodyear[3]). As a result, the incidental catch and discard of juvenile red snapper by shrimpers significantly affect commercial and recreational fishermen who target the adult stocks. Juvenile red snapper become vulnerable to trawl gear during the peak, late-summer shrimping season and continue to be incidentally caught and discarded for more than a year (Goodyear[3]).

The Gulf of Mexico Fishery Management Council currently regulates recreational and commercial red snapper fishermen because the red snapper resource is severely overfished.[4] The commercial fishery for red snapper is regulated with a 15-inch minimum size limit, a quota followed by closure of the fishery when the quota is reached, and a two-tiered system of trip limits under which permit holders with a significant catch history may land up to 2,000 pounds of red snapper per trip while other permit holders are limited to 200 pounds per trip. Annual renewal of the permits requires fishermen to demonstrate that at least 50% of their earned income was obtained from commercial fishing or the operation of a charter or head boat. The recreational fishery is regulated with minimum size and bag limits which can be changed in order to restrain the recreational catch to its annual allocation. Recreational and commercial quotas are set annually, and the 1996 quotas are about 4.5 million pounds for each sector.[5] The minimum size limit for commercial and recrea-

[1]Nichols, S., and G. J. Pellegrin. 1992. Revision and update of estimates of shrimp fleet bycatch 1972-1991. Natl. Mar. Fish. Serv., Southeast Fish. Cent., Miss. Lab., Pascagoula.

[2]*Penaeid* shrimps support the most valuable commercial fishery in the Gulf of Mexico. In 1994, fishermen landed approximately 206 million pounds (whole weight) of shrimp and earned gross ex-vessel revenues of $463 million, which accounted for 10% of total commercial landings and 57% of total ex-vessel revenues received by U.S. commercial fishermen in the Gulf of Mexico (NMFS, 1995).

[3]Goodyear, C. P. 1995. Red snapper in U.S. Waters of the Gulf of Mexico. Contrib. MIA-95/96-05, NMFS Southeast Fish. Sci. Cent., Miami Lab., Miami, Fla., 171 p.

[4]A biological stock assessment completed in 1995 found that the red snapper resource currently exhibits a ratio of spawning potential of less than 4%, whereas the Gulf of Mexico Fishery Management Council has as biological goals the attainment and maintenance of a spawning potential ratio of at least 20%. The spawning potential ratio is defined as the ratio of the biomass of spawners per recruit in the current population vs. what would exist in the unfished population. Current estimates of the spawning potential ratio are found in Goodyear (text footnote 3).

[5]Commercial landings of red snapper exhibited an almost uninterrupted decline from about 14 million pounds in 1965 to 2.7 million pounds in 1990, the last year before quotas were imposed. Because of a relatively fixed quota, fishermen annually landed about 3.1 million pounds of red snapper from 1992 to 1995. Similarly, the estimated recreational catch declined from over 10 million pounds during the early 1980's to only 2 million pounds by 1986 and has since risen to about 5.5 million pounds in 1994 (Goodyear, text footnote 3).

tional reef fishermen is scheduled to increase to 16 inches in 1998. However, the timing of increases in the minimum size limit for recreational fishermen may be accelerated, and the bag limit may become more restrictive in an effort to curtail quota overruns by recreational fishermen. The recreational quota was exceeded in recent years (Goodyear[3]), but the recreational fishery was not closed because there is no real-time monitoring of the recreational catch.

If an ITQ program was implemented, it would have significant and positive economic consequences. Further, as will be noted, an ITQ system will provide the framework for capturing the potential economic benefits from rebuilding the red snapper stock that is related to a reduction in shrimp bycatch.

Given that the Council's minimum long-term goal of a 20% ratio of spawning potential cannot be attained by the target date of 2019 if the incidental mortality of juvenile red snappers by shrimp trawlers is not curtailed (Goodyear[3]), the Council is currently preparing an amendment to the Gulf of Mexico Shrimp FMP to reduce shrimp bycatch by at least 50%. The amendment is controversial because conservation of the red snapper resource via a reduction in shrimp bycatch will mean increased costs for shrimpers while potential benefits would accrue to other commercial and recreational fishermen who target the adult bycatch stocks. Management possibilities being considered under the amendment include area closures, seasonal closures, and the use of bycatch reduction devices (BRD's) in the shrimp trawls.

Regardless of the management device chosen, preliminary analyses suggest that the primary cost of reducing bycatch would consist of the value of shrimp not landed that otherwise would be landed. For example, the mandated use of BRD's would entail the loss of some shrimp per unit of effort. Restrictions on shrimp trawling effort during seasons and/or areas when and where bycatch is most prevalent would also result in a loss of shrimp harvest. The aggregate loss in shrimp catches may result in ex-vessel price increases, but even so, total revenues to shrimpers would still decline because ex-vessel demand for shrimp is price elastic due to the high availability of imported shrimp. Another cost to shrimpers could be expected in the form of higher production costs. Shrimpers who comply with rules designed to reduce incidental bycatch would incur the costs of purchasing

Shrimp trawl bycatch (NMFS photo by James Nance).

BRD's, modifying their gear, and/or disrupting their normal fishing patterns to avoid areas with large concentrations of juvenile red snappers. Consumers of shrimp also would suffer if discard abatement resulted in smaller supplies of shrimp available at higher prices. In this event, larger quantities of imported shrimp would replace some of the reduction in domestic landings, but total quantities available for consumption would decrease because the supply of imports is less than infinitely elastic.

Commercial and recreational red snapper fishermen could benefit in several ways from a reduction in the incidental catch and discard of juvenile red snapper. First, a reduction in bycatch mortality could increase the allowable catches of adult red snapper, which are adjusted annually, by shifting some of the burden of stock enhancement to the shrimp fishery. Red snapper fishermen would benefit immediately if the Gulf Council opted to relax regulatory constraints by allowing them to harvest larger annual quotas. On the other hand, if current regulations on the red snapper fisheries remained unchanged, a reduction in the incidental catch and discard of juvenile red snapper would allow the red snapper resource to recover more quickly to desired levels. In this event, red snapper fishermen would benefit with larger annual quotas in the long-term made possible by faster recovery of the fish stock. Second, recreational and commercial red snapper fishermen would benefit via a potential reduction in harvesting costs. A reduction

in the numbers of juvenile red snapper discarded would increase the numbers of adult red snapper available for capture, both directly as additional juveniles recruit to their adult habitats and over time through a larger spawning population, and would make both locating and harvesting red snapper less time consuming and, hence, less costly.

In the longer term, however, the reductions in harvesting costs would tend to disappear if the existence of larger red snapper populations encourages additional commercial and recreational effort, as is likely under the current open-access type regulations. This is where an ITQ system for the commercial portion of the stocks would be of great use in allowing the potential economic gains from larger stocks to become reality. The implementation of an ITQ system can be fully expected to result in a significant rise in average ex-vessel prices and should result in harvesting efficiencies that would significantly decrease the total cost of harvesting. However, given the absence of similar controls on overall effort by recreational fishermen, there is some chance that a portion of the potential economic gains for that group may not be realized.

Because an ITQ program for management of the commercial allocation of the red snapper stocks has not yet been implemented, the actual effect of a reduction in the incidental catch and discard of juvenile red snapper on ex-vessel prices for red snapper is ambiguous. Current management of the commercial red snapper fishery with restrictive quotas has introduced the psychology of the "derby fishery," in which individual fishermen must fish more intensively earlier in the season to maximize their shares of the overall catch before the quota is reached and the season is closed. While monthly catches of red snapper were relatively uniform throughout the year before the implementation of restrictive quotas, the entire year's catch now is landed in less than 2 months, and these landings are accompanied by sharp declines in ex-vessel prices. If a reduction in bycatch enables commercial fishermen to harvest additional quantities of red snapper, and if the larger allowable harvests in combination with an ITQ system relieve the incentive for derby fishing, then ex-vessel prices would undoubtedly increase relative to current prices. On the other hand, if the derby fishery prevailed, then ex-vessel prices would decline further as increasingly larger quantities would be landed during a relatively short time period.

Consumers would also be affected by management to reduce the incidental bycatch and discard of juvenile red snapper. If derby fishing prevailed in the commercial red snapper fishery, at the beginning of the fishing year consumers of red snapper would benefit from lower levels of incidental bycatch because larger supplies of red snapper would become available at lower cost. However, if the incentives for derby fishing were nullified, then consumption of red snapper at the beginning of the fishing year would decrease and prices would be higher, while consumption during the middle and end of the fishing year would increase and prices would be lower. Larger domestic supplies would displace some imported red snapper, but total quantities available for consumption likely would increase.

From an economic perspective, the optimum reduction in bycatch would be determined by comparing the marginal benefits and marginal costs of each additional reduction in bycatch. In principle, bycatch should be reduced as long as the marginal benefit exceeds the marginal cost of doing so, although these values have not yet been estimated, due to a lack of data. Marginal cost includes the extra cost that would be incurred by shrimpers and consumers from each additional reduction in bycatch, including the present value of losses that would be incurred in the future as well as current-year losses. The easiest, least-cost methods of reducing bycatch would be adopted first. Additional reductions in bycatch can only be achieved with increasingly restrictive regulations on shrimping activity, which suggests that marginal cost increases with each additional reduction in bycatch.

Marginal benefit includes the extra benefit that would be received by harvesters and consumers of red snapper and other animals that would be saved from being discarded, including the present value of the extra current and future benefits that would be generated with each additional reduction in bycatch. Each additional reduction in bycatch is expected to increase total benefits to commercial and recreational red snapper fishermen, but at a decreasing rate. Each additional 10% reduction in bycatch probably would yield successively smaller additions to adult red snapper stocks due to the existence of other environmental factors that tend to limit stock growth. Also, each addition to adult red snapper stocks probably would yield successively smaller additions to profits of

commercial fishermen as they increase their investments in fishing effort to harvest additional quantities, and would yield successively smaller additions to enjoyment of recreational fishermen due to the economic principle of diminishing marginal utility. For example, the first five fish caught per trip by recreational fishermen would yield more enjoyment than the second five if bag limits were less restrictive.

In summary, biologists have determined that the red snapper resource in the Gulf of Mexico is depleted for several reasons, including the application of too much fishing effort by commercial and recreational red snapper fishermen and the incidental bycatch and discard of juvenile red snapper by the shrimp trawl fleet. The ensuing debate about how best to restore the red snapper population to desirable levels involves many technological, political, and economic factors. Among them are technological interaction in which shrimping gear inadvertently harvests juvenile red snapper, management interaction between the Reef Fish FMP and Shrimp FMP, competition between commercial and recreational fishermen and among fishermen with different gear types within each group, economic trade-offs over time among various harvesting groups and between different groups of consumers, and the current uncertainty regarding whether or not the commercial management structure for red snapper will shift to an ITQ-based system. The interaction between the shrimp and red snapper fisheries of the U.S. Gulf of Mexico constitutes a management problem that is controversial, challenging, and, as yet, unresolved.

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Chapter 7

The Northeast Regional Report

The Commercial Harvesting Sector

Introduction

The Northeast Region's commercial oceanic and estuarine fisheries produced domestic landings worth $869 million at dockside in 1993. Figure 7-1 shows a 10-year trend of landings and ex-vessel revenue of finfish and shellfish landed or raised in the Northeast Region. In 1993, finfish landings accounted for 35% of the revenue generated in the region. The real prices, weight, and real ex-vessel value of the ten most valuable species of fish and shellfish landed or raised in the Northeast Region in 1993 are shown in Table 7-1 for the period 1984-93[1]. Of the top ten, seven are invertebrates and five are harvested predominantly inshore (0-3 miles). Over the 10-year period, many changes have occurred in the landings, value, and ranking of the most valuable species. For instance, both sea urchins and Atlantic salmon have experienced very dramatic increases, both from essentially zero value to the eleventh and sixth most valuable species, respectively. Landings of sea urchins have increased from 45 metric tons (t) in 1984 to 19,200 t in 1993, with a real value of $21.9 million. The rapid development of this fishery continues almost unchecked except for the adoption by the state of Maine of a closed season during summer months when sea urchin roe is much less appetizing to the Japanese consumer. The presence of farmed fresh Atlantic salmon as the current sixth highest valued species in the Northeast illustrates the growing importance of marine aquaculture to the Northeast economy.

Lobsters and scallops have continually been the two most valuable species in the Northeast Region. Scallop value dropped drastically in 1993 by 36%, while landings declined by 48%. In an effort to save the resource, the meat-count standard of regulation was replaced in 1994 with limits on the

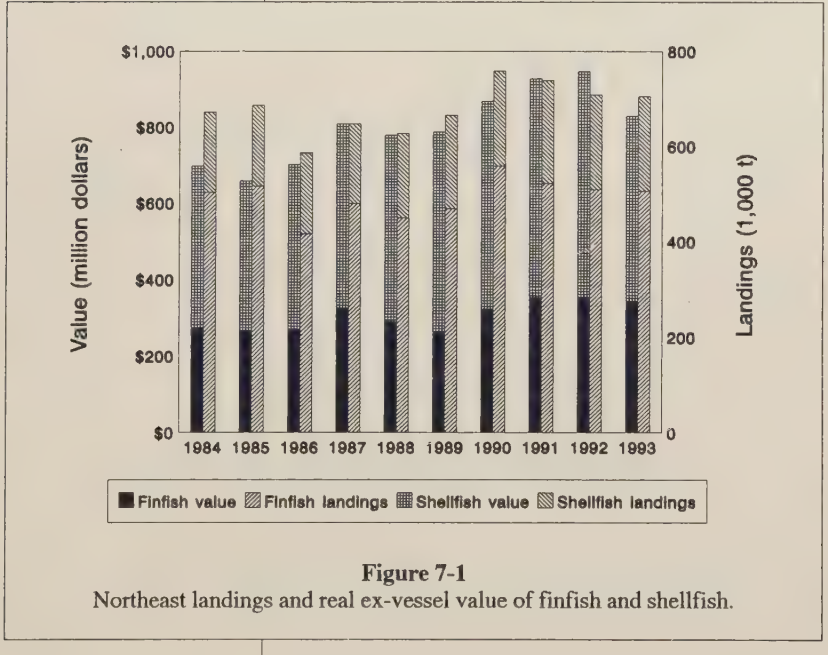


Figure 7-1
Northeast landings and real ex-vessel value of finfish and shellfish.

[1]Landings of finfish, lobster, shrimp, and crab are given in live weight; landings of all other shellfish are expressed in meat weight. Value and price are expressed in real dollars.

Farmed Atlantic salmon from Maine (NMFS photo by William B. Folsom).

number of days vessels can spend at sea, a moratorium on new entrants, and permitting requirements.

Another notable trend in the Northeast is the continued decline in landings of the region's "traditional" groundfish species (cod, haddock, and yellowtail flounder), which fell from 72,100 t in 1984 to 27,400 t in 1993. The real value of these traditional groundfish landings has also decreased since 1984 by almost 50%, from $91 million to $46.8 million. In 1993, these species accounted for 7% of total catch by value (4% by weight). Haddock and yellowtail, not included in Table 7-1 since they are no longer in the top ten listing of highest valued species, ranked thirty-third and twentieth in terms of value in 1993, respectively, down from twelfth and eighth in 1984. Figure 7-2 shows landings and prices for the traditional groundfish mix.

An indication of the relative importance of gear types, by revenue earned, is shown for 1993 landings in Table 7-2. Otter trawls produced the greatest percentage of total revenue, followed by combined inshore and offshore lobster gear and sea scallop dredges. These three gear types accounted for over half of the region's ex-vessel revenue, a percentage that has been shrinking as effort has shifted to the harvest of nontraditional species with other gear types. Menhaden purse seines and bottom otter trawls account for over half of the landings by weight. Many vessels and boats employ more than one gear type. The ability to change from one fishing method to another is of particular importance in fisheries where different species are harvested, requiring different techniques at various seasons of the year.

Vessels equipped with otter trawls land different species depending on the area in which they fish. Figures 7-3 and 7-4 compare the species composition by value for New England and Mid-Atlantic otter trawls for 1993.

Figure 7-5 shows the total number of identifiable vessels (those vessels of known tonnage, excluding undertonnage vessels) using scallop dredge, otter trawl, and other gear from 1984 through 1993. In 1993, the total number of vessels in the Northeast Region was at one of its highest levels. Combined with the constant or declining trend in landings, this provides some evidence of overcapitalization in Northeast fisheries. There has been an increase in the number of vessels using otter trawl gear and a decrease in the number of scallop dredge vessels.

Table 7-1

Volume (1,000 t), real ex-vessel value (million dollars), and real price per pound of the ten most valuable species landed or raised in the Northeast Region in 1993.

Species	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Lobster										
Volume	20.6	21.3	20.8	20.8	22.2	24.0	27.6	29.1	26.0	28.0
Real value	$134.4	$123.9	$123.9	$142.1	$140.9	$137.3	$133.0	$141.0	$137.7	$157.3
Real price	$2.96	$2.64	$2.70	$3.10	$2.87	$2.60	$2.19	$2.20	$2.40	$2.54
Sea scallops										
Volume	7.7	6.8	8.3	13.2	13.0	14.4	17.2	17.2	14.2	7.5
Real value	$103.5	$76.3	$93.9	$123.4	$117.3	$116.7	$129.9	$130.3	$127.1	$78.7
Real price	$6.10	$5.09	$5.13	$4.23	$4.08	$3.67	$3.42	$3.44	$4.05	$4.85
Blue crab										
Volume	45.8	48.0	42.9	38.9	41.8	45.6	43.9	49.5	30.1	57.1
Real value	$36.4	$38.1	$35.4	$37.6	$39.1	$38.7	$38.1	$34.3	$28.7	$56.0
Real price	$0.36	$0.36	$0.38	$0.44	$0.42	$0.38	$0.39	$0.31	$0.43	$0.44
Cod										
Volume	43.9	37.4	27.6	26.8	34.6	35.6	43.6	42.2	27.9	22.9
Real value	$39.7	$37.1	$37.2	$44.2	41.4	44.0	$54.1	$63.1	$43.2	$36.2
Real price	$0.41	$0.45	$0.61	$0.75	$0.54	$0.56	$0.56	$0.68	$0.70	$0.72
Hard clam										
Volume	5.0	5.7	4.7	5.0	6.8	4.2	4.6	4.4	4.3	4.3
Real value	$41.3	$48.5	$41.9	$50.3	$46.9	$46.6	$41.4	$38.0	$33.7	$35.1
Real price	$3.75	$3.86	$4.08	$4.59	$3.13	$5.05	$4.08	$3.91	$3.56	$3.68
Atlantic salmon										
Volume	—	—	—	—	—	—	2.1	4.7	5.8	6.7
Real value	—	—	—	—	—	—	$14.2	$25.5	$37.5	$34.3
Real price	—	—	—	—	—	—	$3.08	$2.46	$2.91	$2.30
Menhaden										
Volume	261.1	314.6	222.6	300.0	273.5	287.8	336.1	294.8	285.9	317.0
Real value	$30.4	$32.9	$25.1	$32.5	$28.6	$28.8	$32.8	$28.2	$26.1	$33.7
Real price	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.04	$0.04	$0.04	$0.05
Surf clam										
Volume	32.9	32.1	35.4	27.4	28.6	30.4	32.6	30.0	33.2	33.5
Real value	$38.5	$40.0	$43.5	$27.9	$27.9	$28.3	$28.5	$24.8	$28.7	$30.8
Real price	$0.53	$0.57	$0.56	$0.46	$0.44	$0.42	$0.40	$0.37	$0.39	$0.42
Oyster meats										
Volume	7.2	6.7	6.8	4.3	3.1	2.4	3.3	4.0	4.6	2.9
Real value	$44.0	$31.8	$39.0	$29.5	$25.2	$20.5	$35.3	$34.6	$46.4	$29.6
Real price	$2.77	$2.15	$2.59	$3.11	$4.66	$3.83	$4.88	$3.97	$4.50	$4.68
Squid loligo										
Volume	10.5	9.0	11.5	10.5	18.9	23.0	15.0	19.4	18.2	22.3
Real value	$6.8	$6.6	$9.3	$9.3	$14.9	$20.1	$12.4	$19.3	$19.3	$23.9
Real price	$0.29	$0.33	$0.36	$0.40	$0.36	$0.40	$0.37	$0.45	$0.48	$0.49

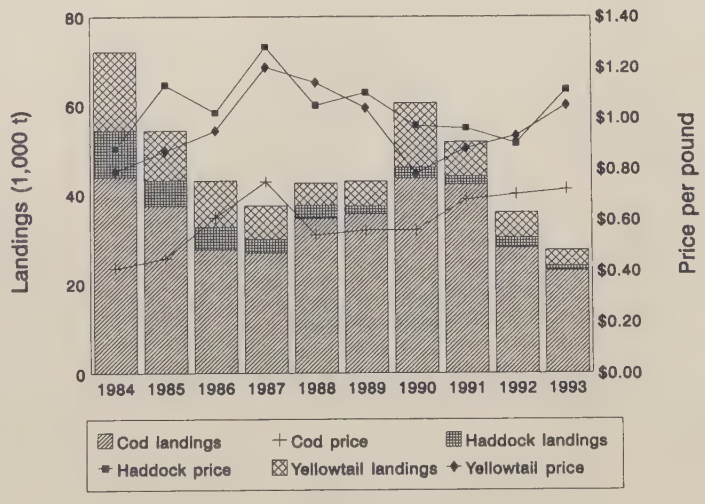


Figure 7-2

Northeast landings and real price of cod, haddock, and yellowtail flounder.

Table 7-3 shows the number of vessels and boats granted permits by fishery category and gear type for 1993. Frequently, vessel owners apply for a permit in several different fisheries and for several gear types. Hence, the total number of permits issued is far greater than the total number of unique vessels or boats. The greatest number of permits issued was for rod-and-reel use in several fisheries by both vessels and boats. These permits are used principally for catching bluefin tuna.

Employment levels in the harvest sector in the Northeast are difficult to estimate. Data from 1987 and 1992 censuses estimated that over 72,000 persons have at least part-time dependence as harvesters on the commercial fisheries of the region. Half of these were fully dependent on fishing, employed as vessel and boat owners or crew.

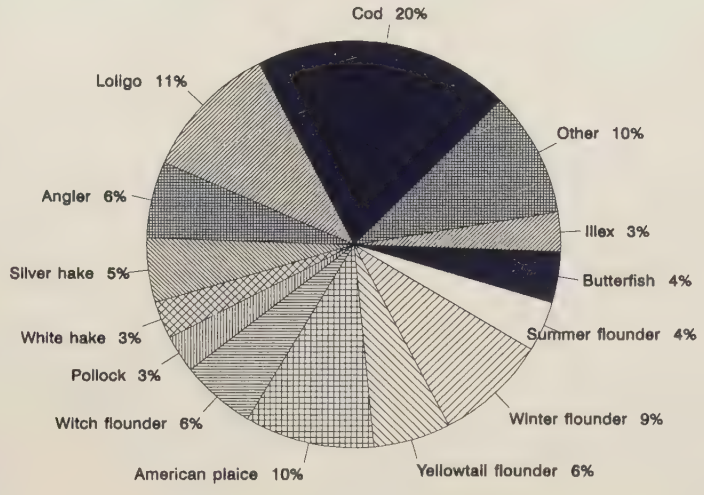


Figure 7-3
New England bottom otter trawl, 1993 species composition by value.

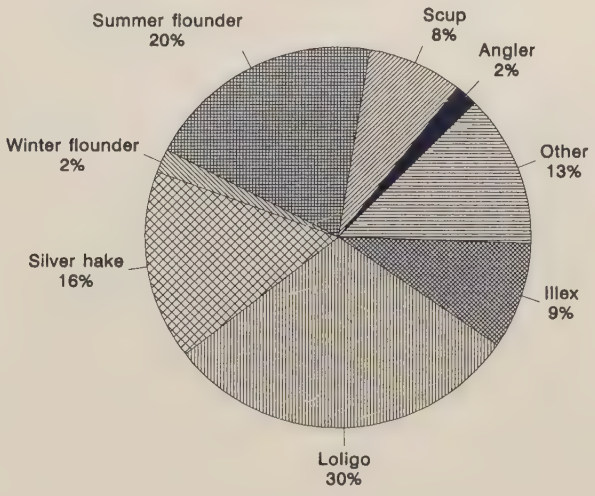


Figure 7-4
Mid Atlantic bottom otter trawl, 1993 species composition by value.

Table 7-2
Landings and ex-vessel revenue in the Northeast Region in 1993, by gear type.

Gear type	Landings (1,000 t)	Revenue ($millions)
Otter trawl, bottomfish	129.73	187.0
Pots and traps, lobster	28.02	157.3
Dredges		
Sea scallop	11.36	102.6
Surf clam, ocean quahog	55.97	53.7
Purse seines, menhaden	310.86	40.9
Pots and traps, blue crab	25.92	32.4
Longlines, bottom and pelagic	7.66	29.7
Sink gill nets	22.69	24.8
Diving gear	16.65	24.3
Rakes	1.76	17.8
Hoes	1.47	12.8
Handlines, other	0.91	12.7
Tongs and grabs	0.62	7.1
Dredges, clam	0.58	6.0
Purse seines, herring	38.43	5.1
Otter trawl		
Bottom–shrimp	2.20	5.0
Bottom–scallops	0.47	4.4
Dredges, oyster	0.23	1.9
Unknown[1]	15.05	95.0
All other gears	40.47	50.6
Total	711.05	871.2

[1]Unknown for 1993 includes oyster dredge.

Table 7-3
Permits issued in the Northeast Region in 1993, by gear type.

Proposed gear use	No. of vessels	No. of boats
Bottom, mid-water, and other trawls	2,157	156
Dredges	1,474	187
Gill/entanglement nets	625	225
Handlines	1,971	1,531
Rod and reel	3,800	2,918
Longlines, set lines	955	241
Other gear	2,623	858
Total permits	13,605	6,116

Alternatively, the Bureau of Economic Analysis[2] estimates total employment in the harvesting sector of all Northeast fisheries at 15,300 (1992).

Northeast Fisheries Management

Since the passage of the Magnuson Fisheries Conservation and Management Act (MFCMA) in 1976, most commercially important species caught in the Northeast Region's EEZ have come under fishery management plans (FMP's) or preliminary plans promulgated by either the New England or Mid-Atlantic Fishery Management Councils (NEFMC or MAFMC). Table 7-4 lists all Northeast FMP's, the gear regulated, and the type of management.

FMP's are in effect in the Northeast Region for multispecies groundfish (consisting of 13 demersal species), summer flounder, sea scallops, surf clams and ocean quahogs, offshore lobster, and squid, mackerel, and butterfish. There is also an FMP for Atlantic salmon, but no fishing is currently allowed for the species. Various management strategies in effect within these FMP's include traditional indirect methods such as mesh size limits, time area closures and effort restrictions in the form of time limits or days at sea. The current decline in stocks of traditionally harvested species is testimony to the effectiveness of these types of management measures. In some fisheries, ITQ's, quotas, and limited entry plans are in effect. Many fishermen are affected by restrictions under multiple plans.

Various regulatory schemes have been implemented to manage Northeast groundfish stocks. In 1993, the NEFMC approved Amendment 5 to the Northeast Multispecies Fishery Management Plan to restrict days at sea for vessels over 45 feet, in order to reduce fishing mortality by 50% over the next 5-7 years (10 years for haddock). Amendment 5 also imposes a vessel moratorium on most new entrants; mesh size increases; minimum fish sizes; seasonal and area closures (of haddock spawning grounds); vessel, dealer, and operator permits; and mandatory reporting. Pair trawling for groundfish was banned. Also, sink gillnetters must remove nets from the water at specified times and areas to reduce bycatch mortality of harbor porpoises. Longliners fishing

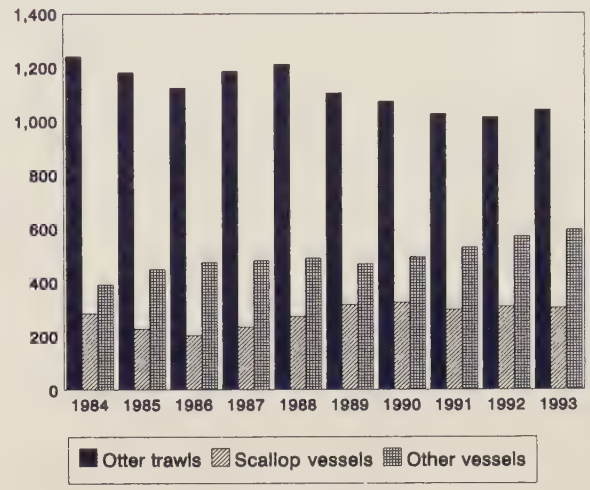


Figure 7-5
Number of otter trawls, scallop dredges, and other vessels operating in the Northeast.

4,500 hooks or less were exempted. A lawsuit brought against the Federal government by a New England environmental group eventually led to the development and passage of Amendment 5.

Since Amendment 5 was quickly found inadequate to restore groundfish stocks, a temporary closure of four areas under an emergency action was imposed by the Department of Commerce in December 1994. The NEFMC's long-term plan for restoring the groundfish stocks, Amendment 7, is expected to take effect in 1996; further reductions in days at sea, area closures, and the establishment of a quota for the remaining groundfish stocks outside of the closure areas are currently under consideration. One of the major concerns will remain the ramifications of closed areas and the subsequent shift in effort by the displaced vessels.

The MAFMC amended its summer flounder (fluke) plan in conjunction with ASMFC as a result of the 1989-90 crash in landings. New rules of Amendment 5 include a 12.35 million pound quota divided among the Northeast states (based on 10 years of historical landings), an increase in mesh size, and a mandatory reporting program. There is a requirement for the use of turtle excluder devices (TED's) south of Oregon Inlet, N.C., to prevent the incidental capture of sea turtles in the bottom trawl flounder fishery. Amendment 7 would revise the fishing mortality rate reduction schedule for summer flounder.

[2]Unpubl. data (1992) compiled for the NOAA Office of Sustainable Development.

Table 7-4
Commercially exploited species in the Northeast EEZ managed by NEFMC or MAFMC.

FMP	Gear	Entry control	Management
NE multispecies: Cod, haddock, yellowtail flounder, pollock, winter flounder, witch flounder, windowpane flounder, American plaice, redfish, white hake, red hake, whiting, ocean pout	Directed and mixed trawl	Control date 2/21/91, moratorium	DAS, mesh size, fish size, area closures NR[1]
Summer flounder	Directed and mixed trawl	Control date 1/26/90, moratorium	Quota, mesh size, fish size
Sea scallops	Scallop dredge, otter trawl	Control date 3/1/90, moratorium	DAS, gear restrictions, catch limits on non-DAS effort
Ocean quahog and surf clam	Clam dredge	Moratorium	ITQ
American lobster	Traps	Control date 3/25/91	Size limit
Squid	Small mesh trawl	Control date 8/93	Quota (not limiting)
Butterfish	Small mesh trawl	Control date 8/93	Quota (not limiting)
Atlantic mackerel	Directed and mixed trawl	Control date depends on TAC	TAC (not limiting)
Scup	Directed and mixed trawl, small mesh trawl pots	Control date 1/26/90, moratorium	Quota, fish size NR
Atlantic herring	Purse seine, mid-water trawl, weirs	None	3 area TAC, spawning area closure
Goosefish	Scallop dredge, directed and mixed trawl, gillnet	Control date 2/27/95	NR
Tilefish	Longline, mixed trawl	Control date 6/93	NR
Black sea bass	Pots, mixed trawl	Control date 1/26/90, moratorium	NR
Bluefish	Gillnet, otter trawl, pound net	None	Annual quota NR

[1]NR=New or revised plan in development.

The East Coast Sea Scallop Plan (known as Amendment 4), administered by the NEFMC, replaced the meat-count standard with limits on days at sea, gear restrictions, a moratorium, crew size limits, and mandatory reporting. Also, all full-time, part-time, and occasional scallopers are required to participate in a vessel call-in program. Operators, vessels, and dealers must have permits. Days at sea were allocated based on historical participation and classification as full-time, part-time, or occasional scallopers. Although it is under discussion, there are no extant plans to allow for consolidation of the days at sea allocation.

The first individual transferable quota (ITQ) system in a Federally regulated fishery was for offshore surf clams and ocean quahogs. Amendment 8, in effect since September 1990, provided for the allocation of initial ITQ shares that can be traded or leased to any entity. Under the ITQ system, effort limitations and minimum size regulations have been eliminated. Logbooks containing performance variables are required for the surf clam and ocean quahog offshore fleet. For a discussion of the effect of ITQ management on the performance of the surf clam and ocean quahog fishery, see this region's spotlight article.

Amendment 5 of the American Lobster Fishery Management Plan by the NEFMC provides for a 5-year moratorium on entry into the fishery, the establishment of four different lobster management areas, and a mechanism through which yet undefined lobster regulations will be implemented for each area. Instead of a gauge increase, Amendment 5 aims to reduce fishing effort by various effort control measures, area and season closures, improved data collection, trap limits, and operator permits. The particular effort-control restrictions are being developed during the initial year of the plan by regional Effort Management Teams (EMT).

Another Federal FMP, for squid, Atlantic mackerel, and butterfish, Amendment 4, has existed since 1992. Each year, the MAFMC recommends a quota for each species, and recommends whether the provision for a TALFF should be filled, decisions that can later be adopted by the Secretary of Commerce.

In the Northeast Region, fishing in inland waters and near shore (<3 miles) is monitored and regulated by the individual states in New England, the Mid-Atlantic, and the Chesapeake area. Certain near-shore and inshore fisheries come under the jurisdiction of interstate bodies such as the Atlantic States Marine Fisheries Commission (ASMFC), which performs the coordinating function for species whose range in the territorial sea spans several states.

Major Economic Issues in the Northeast Region

The most obvious issue to many fishermen in the Northeast at the present time concerns the stringent restrictions placed on their fishing behavior by the current closed areas and the anticipated restrictions under the upcoming

Amendment 7 to the groundfish plan as well as Amendment 4 to the scallop plan. Both fisheries have imposed a moratorium on new entrants and severely restricted the days at sea that a vessel may fish and where it can fish. These types of management tools have historically encouraged fishermen to increase their vessel capacity by the altering of other inputs.

Several issues are important from an economic standpoint, due to the groundfish crisis. One concerns the effect of the displacement of fishing effort from current and future closed areas. Another issue is the potential that a vessel retirement/buyback program may have toward reducing the excess capacity existing in the Northeast and helping to speed resource recovery and keep exploitation rational after implementation. To be most effective, a buy-out program must be designed carefully to ensure efficient and equitable decisions under a variety of fisheries in the Northeast.

A current source of aid to the fishermen in the Northeast has come from the Northeast Fisheries Assistance Program (NFAP), consisting of a $30 million emergency aid package. The aid is being used to fund revolving loan funds and to encourage aquaculture operations, the harvest of underutilized species, and new business opportunities. Fishing Family Assistance Centers have also been set up in the Northeast to give advice to those who are dependent on the fishing industry for their livelihood.

Effort controls imposed by FMP's, such as restrictions on gear, time limits, area closures, etc., are intended to maintain or rebuild stocks, but they also reduce the productivity of any fishing enterprise and therefore increase the unit-cost of harvesting fish. Estimates of the costs of efficiency-reducing (or stock rebuilding) regulations in the Northeast are not yet available.

The NEFMC has attempted to reduce significantly the take of harbor porpoises through an adjustment to Amendment 5 of the Multispecies Plan. This effort will most likely continue under Amendment 7. This issue arose due to a conflict of interest between gillnet fishermen and groups who value marine mammals over the harbor porpoise bycatch. Much work remains to be done, including evaluation of the porpoise population size and economic ("existence") value of harbor porpoises. The future management of groundfish will likely be affected by the relative costs and benefits of protecting harbor porpoise.

The use of underutilized species (mackerel, herring, dogfish) has received greater attention as concern rises over the levels of traditional groundfish stocks and fishermen's ability to harvest them. Implicit in the discussion of underutilized species is the necessity for market development (domestic and export), whether it be by fishermen or subsidized by the government. The degree of success of product research and market development may be limited, since these species are traditionally low value and in adequate supply around the world.

Another issue of economic importance to the Northeast Region concerns the transboundary stock management by the U.S. and Canada. Since the dramatic closures imposed by the Canadian government to save Newfoundland's and Nova Scotia's cod stocks, major shifts have occurred in the structure of production and trade in fish products. Clearly, a low supply of marketable fish affects the harvesting, processing, and trade sectors. A cutback in the supply of Canadian groundfish may affect New England ex-vessel price (depending on the availability of other international substitutes), increase demand for traditional New England species, and have impacts on the level of trade with Canada and other countries. An opportunity exists for increased cooperation between the United States and Canada on stock management and data sharing that could influence the effectiveness of the management plans along the border.

The Seafood Processing Sector

Changes in the Northeast fishing industry over the last 10 years have altered the makeup of the processing and wholesaling sector. Domestic landings of groundfish and scallops have declined since the early 1980's (Georgianna et al.[3]), causing firms that either process or wholesale groundfish or scallops to meet a relatively stable demand with increased use of imports. Since 1988, groundfish imports from Canada (25.5% of all 1993 imports came from Canada [NMFS, 1995]) have steadily declined (Georgianna et al.[3]) often making it difficult to obtain fresh supply. Other regulatory changes, such as the 1986 duty

[3]Georgianna, D., J. Dirlam, and R. Townsend. 1993. The groundfish and scallop processing sectors in New England. Final Rep., U.S. Dep. Commer. Contr 50EANF-2-00065.

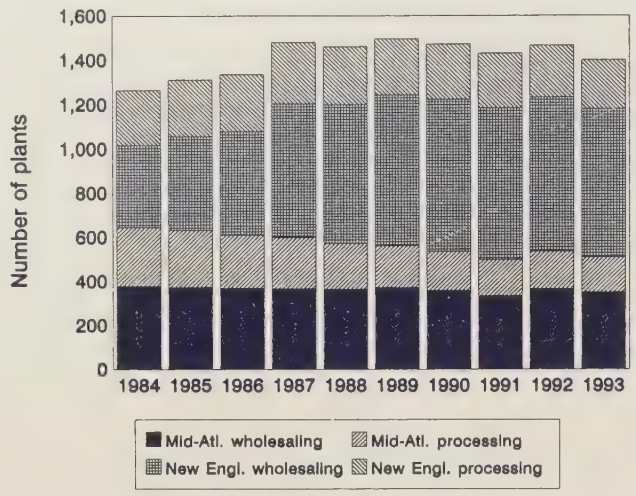


Figure 7-6
Processing and wholesaling plants in the Northeast.

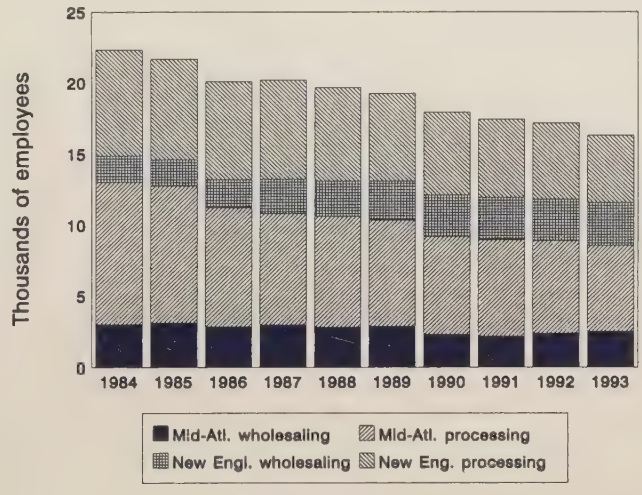


Figure 7-7
Year-round employees in processing and wholesaling in the Northeast.

on whole fish from Canada (Georgianna et al.[3]), have also affected the way processors do business.

As a result of changes in both the condition of fishery resources and the business environment, the mix of processing and wholesaling plants in the Northeast has been altered. Figure 7-6 shows the number of processing and wholesaling plants in the Mid-Atlantic and New England regions. Since 1983, the number of processing plants in New England has remained steady at about 250. The number of wholesaling plants in New England, however, increased 113%, from 314 in 1983 to 670 in 1993. The number of Mid-Atlantic processing plants decreased by 41%, from 274 to 161, while wholesaling plants decreased 10%, from 387 to 348 over the same period.

Changes are also reflected in the number of year-round (as opposed to seasonal) employees in these sectors, as shown in Figure 7-7. Although the number of New England processing plants remained steady, the number of employees decreased 37%, from a high of 7,470 in 1984 to 4,743 in 1993. Employment among New England wholesalers increased 80%, from 1,690 in 1983 to 3,049 in 1993. Mid-Atlantic processing plants decreased their employment 44%, from a high of 10,015 in 1984 to 5,635 in 1993. Mid-Atlantic wholesaling employment decreased 10%, from 3,203 in 1983 to 2,882 in 1993 (NMFS, 1995).

Product Forms

Fish and shellfish are transformed into various products such as filleted, cooked, breaded, batter coated, canned, cured, or industrial products. The most significant product form (by value) in the Northeast is fresh or frozen fish—cooked, breaded, or batter coated (Fig. 7-8). Of the total fresh or frozen fish fillets, steaks, or portions processed in the Northeast in 1993, New England produced 92%. The Mid-Atlantic region produced 73% of the canned product and 91% of the cured product.

Almost all groundfish landed in the United States and those imported fresh and whole are processed into fresh fillets (Georgianna et al.[3]). Since the NMFS Processed Products Annual Survey does not distinguish between fresh and frozen product, the relative amounts of each are not reported. There is concern that frozen product is sometimes sold as fresh but little evidence of this has been found in New England (Georgianna et al.[3]).

Three percent of Northeast processed product is used for industrial purposes. Fish and shellfish meal, fish oil, and fish solubles are used in end products such as animal food, fertilizer, and lubricants. A major portion of the industrial products produced in the Northeast come from the menhaden fishery.

Quantity and Value of Northeast Processed Product

The following figures describe the changes in quantity and value of fish and shellfish processed (those landed domestically, transported from other regions, and imported from other countries) in the Northeast since 1983. Data are not available on wholesale sector activities. Figure 7-9 shows total pounds processed since 1983, and Figure 7-10 shows real value.

Groundfish processing reached a peak in volume and value in 1986 (Table 7-5 lists the species contained in each species group). Both volume and value then declined over the next 3 years by 52% and 30%, respectively. The year 1990 saw a

Table 7-5
Species groups used in Northeast regional report.

Species group	Species
Groundfish[1]	Cod, cusk, flounder (all kinds), haddock, ocean perch (redfish), ocean pout, pollock, whiting (silver hake), tilefish, Atlantic wolfish (catfish), scup (porgy), red hake, white hake, sea basses, goosefish (anglerfish or monkfish)
Other finfish	Alewives, anchovies, halibut, bluefish, bonito, buffalofishes,white perch, butterfish, carp, catfish, bullheads, chubs, croaker, dolphinfish, eels, groupers, sea catfish, herring, lumpfish, mackerel, marlin, mullets, pompano, rainbow trout, rockfishes, sablefish, salmon, swordfish, tautog, tilapias, sea trout, shad, sharks (mostly dogfish), skates, snapper, Spanish mackerel, steelhead trout, striped bass, sturgeons, sunfishes, whitefish, turbots, other
Mollusks	Clams, mussels, scallops, oysters
Crustaceans	Crab, lobster, shrimp
Other nonfinfish	Snails (conches), squids, sea urchins, turtles, seaweed (Irish moss and kelp w/herring), marine shells, other shellfish

[1]This grouping is based on the biological definition of groundfish and not just the groundfish listed under the Northeast Multispecies Plan. Refer to text footnote 6 for those species.

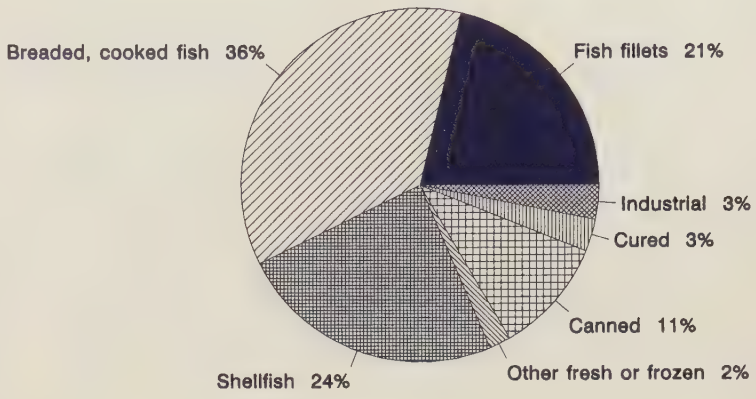


Figure 7-8
Northeast processed products' share of value, by product form. Data from the NMFS (1987) was used because more recent data was not available.

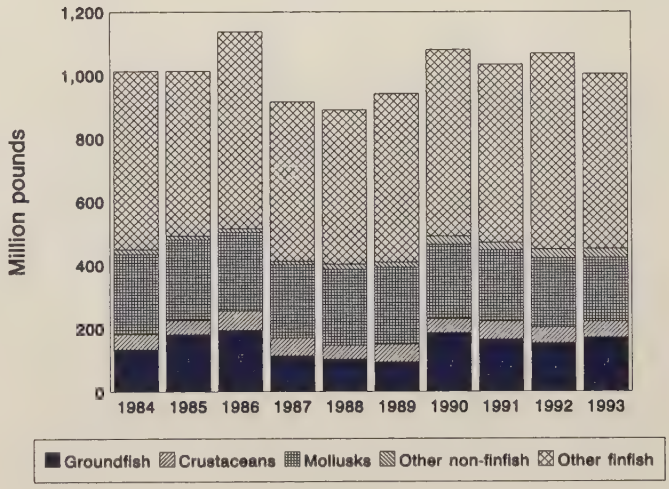


Figure 7-9
Total pounds processed in the Northeast.

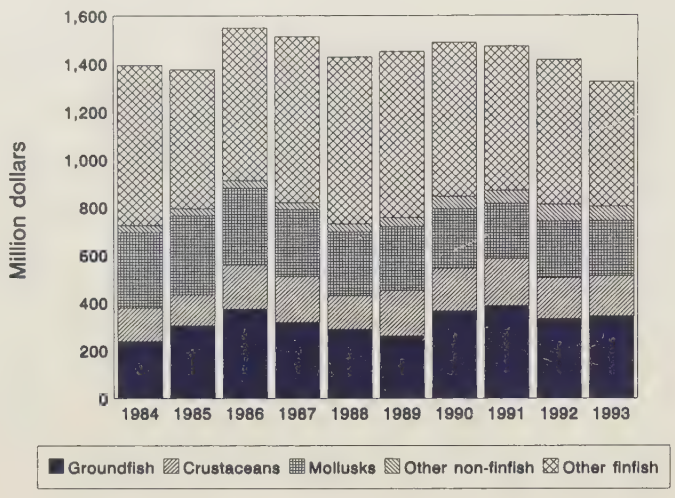


Figure 7-10
Real value of processed product in the Northeast.

near doubling in volume and a 40% increase in value. Processing of other finfish has remained fairly steady since 1983. The lowest production year was 1988 but it appears that an increase in prices from 1985 to 1988 actually increased revenue even though production was declining.

Mollusk processing, dominated by clams, has been steadily declining since the early 1980's. Value has declined steadily since 1985 while quantity has declined steadily since a high in 1984, except for upturns in 1988 and 1989. Although scallop harvesting is a significant activity in the Northeast, scallop processing is less significant since most scallops are shucked at sea and sold to dealers in 40-pound bags. Typically, they are then repacked and wholesaled to restaurants (Georgianna et al.[3]). Since these activities are not considered processing, they do not get reported in the NMFS Annual Survey of Processors.

Crab and shrimp processing dominate the Northeast crustacean processing activities. Lobsters constitute a relatively minor portion because, similar to scallops, the majority are wholesaled. Other nonfinfish processing has increased substantially (150% in amount and 126% in value) since 1987, due primarily to the increase in demand for sea urchins. In 1987, 141,000 pounds of sea urchins were processed, and in 1992 the figure rose to 3.8 million pounds (2,575%). Value increased from $238,000 to $11,635,000 (4,789%) during the same period. Production then dropped to 1.9 million pounds, while value increased to $12,085,000 in 1993. The reason for the 1993 decline in volume processed is that, although landings of sea urchins increased from 26.9 million pounds in 1992 to 41.1 million pounds in 1993, processors switched from exporting whole sea urchins to exporting only the roe, which weighs less.

Impacts of Fluctuations in Supply

The challenge for processors supplying the fish market is to balance demand with the ever changing fluctuations in supply. Restaurants and retailers demand consistent quality, quantity, and prices from processors. This is especially difficult when the resources on which processors depend are declining or when management affects the flow of product over time.

Fluctuations in quantity come from seasonality of certain fisheries, declining stocks, and changes in import sources. For example, domestic groundfish stocks have steadily declined, forcing processors to look to Canadian and Pacific stocks. However, Canadian stocks have not fared any better than U.S. Northeast stocks, forcing processors to look even farther from home for species such as cod, haddock, and flounders. Scallops are also being imported from Canada and other countries as substitutes for U.S. scallops (Sutinen et al.[4]). In response to dwindling supplies of more traditional species, processors are focusing efforts on other species such as orange roughy from Australia, New Zealand, and the Far East, and farmed fish such as tilapia, mahi mahi, catfish, and salmon (Georgianna et al.[3]). Both harvesters and processors have been trying for decades to promote underutilized species such as mackerel, skate, and dogfish.

Amendment 5 to the Northeast Multispecies Fishery Management Plan will have significant impacts on the processing sector. In a bioeconomic analysis of the amendment, completed by the Groundfish Plan Development Team[5] of the New England Fishery Management Council, landings and gross revenue (to the harvest sector) projec-

[4]Sutinen, J. G., P. Mace, J. Kirkley, W. DuPaul, and S. Edwards. 1992. Consideration of the potential use of individual transferable quotas in the Atlantic sea scallop fishery, volume 5. Rep. prep. under NOAA Contr. 40AANF101946, 40AANF100542, 40AANF201227.

[5]Groundfish Plan Development Team. 1993. Bioeconomic evaluations of the impacts of Amendment #5 alternatives. Rep. to New Engl. Fish. Manage. Counc. Meet., 13-14 Jan. 1993.

tions of the ten species[6] covered by the amendment were estimated (Fig. 7-11). Landings are expected to decline by about 10% during the first 5 years of the plan and then rebound above current levels. With a lower level of landings, processors will find it harder to find domestic supplies of traditional groundfish species for the fresh fish market. Since ex-vessel prices are expected to rise as landings fall, the cost to processors will rise. However, when landings rebound in year six, ex-vessel prices will likely fall, easing the burden on processors.

Historically, processors turned to imports as domestic stocks declined. With groundfish, this is becoming more difficult because Canada, a major supplier of the fresh fish market, has completely closed some of its major fishing grounds. Because of the distances involved, importing fresh fish from other areas of the world is not always feasible. Most processors and wholesalers will not substitute frozen fish for fresh fish because of quality problems.

The next several years will be a period of great economic uncertainty for groundfish processors. Many firms will exit the industry because they cannot obtain adequate supplies at a reasonable price. The remaining firms will probably emerge financially stronger and better able to withstand future fluctuations in supply. For firms to survive the likely future fluctuations, they will need to diversify and be able to market a greater variety of products than just traditional groundfish.

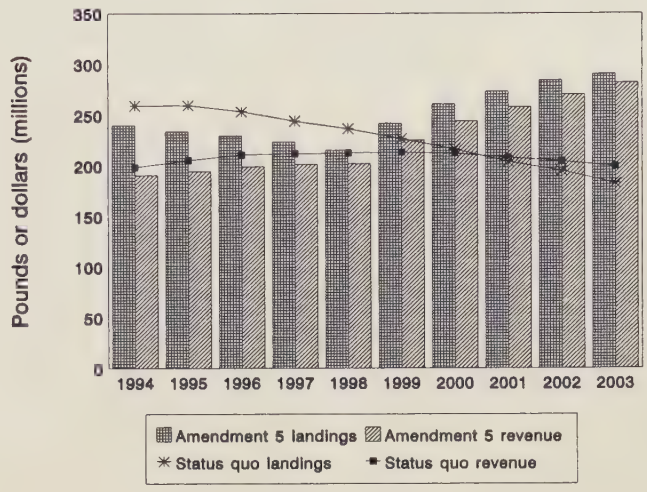


Figure 7-11
Projected Northeast groundfish landings under Amendment 5.

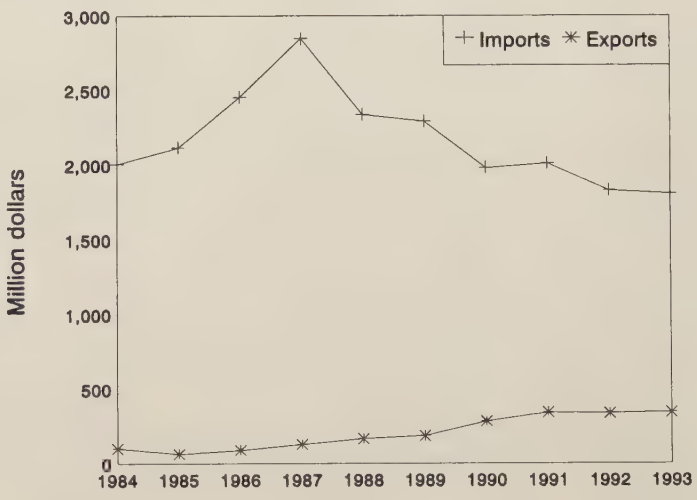


Figure 7-12
Northeast Region trade in edible fishery products.

The Trade Sector

The Northeast Region typically runs a trade deficit (more seafood is imported than exported) in edible fishery products because of a large port-of-entry in New York, the proximity to Canadian fishing grounds, and the magnitude of Canadian imports. Figure 7-12 shows both the value of imports to and exports from the Northeast Region during 1983-93. Imports peaked in value during 1987 and have been declining ever since, while the value of exports peaked in 1991 and has declined the last 2 years.

A trade deficit in fishery products is not a "bad" thing to have. Processors located in the region have access to product from foreign countries when local supply is not available or is not sufficient to meet demand. Consumers are able to purchase a wide variety of products throughout the year at lower prices. Additionally, it has been estimated that as much as 70% of the edible fish that is imported into the Northeast Region is eventually shipped to other parts of the country (NEFC, 1991). This can generate jobs and income

[6]Atlantic cod, haddock, pollock, redfish, American plaice, witch flounder, yellowtail flounder, winter flounder, windowpane flounder, and white hake.

in the region in the processing sector and the transportation industry that moves products from the port-of-entry or processing plants to their final destinations.

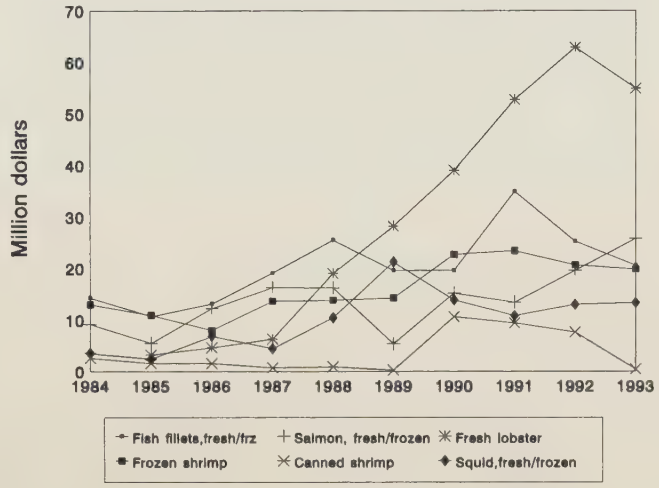


Figure 7-13
Northeast Region value of selected fishery products exports.

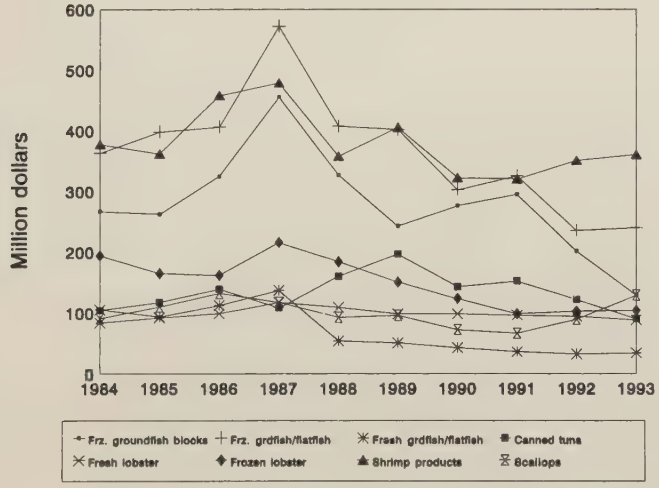


Figure 7-14
Northeast Region value of selected fishery products imports.

Significant Exported and Imported Seafood Products

The five most valuable products exported from the Northeast Region during 1993 were fresh lobsters ($68.2 million), sea urchin roe ($43.8 million), fresh or frozen salmon ($32 million), fresh or frozen fish fillets ($25.6 million), and fresh or frozen squid ($16.5 million). Sea urchin roe has increased 344% in export value since 1991 ($12.75 million) because of strong demand in the Japanese market. Lobster exports have increased in both value and volume almost 1,700% since 1985.

The five most valuable product groups imported into the Northeast Region during 1993 were: shrimp products ($447.6 million), frozen groundfish and flatfish fillets ($297.8 million), frozen groundfish blocks ($160.4 million), scallops ($160.3 million), and frozen lobster ($128.6 million). Declines in imports of frozen groundfish blocks (54% from 1991 levels of $347.9 million) are due to the decline in imports from Canada. Canada, which has traditionally been the biggest supplier of fishery products, closed many of its Atlantic fishing grounds because of sharp declines in groundfish resources.

Important Trends in Northeast Trade

Because of the variety of different products exported from the Northeast Region and the change that took place in the Harmonized Tariff Schedule of the U.S.A. (HTSUSA) codes beginning in 1989, six product categories were chosen to examine trends in exports during 1983-93. Product categories include: fresh or frozen fish fillets, fresh or frozen salmon, fresh lobster, frozen shrimp, canned shrimp, and fresh or frozen squid. Trends in the values for all six product categories can be seen in Figure 7-13.

Between 1984 and 1993, the volume of salmon exports rose 350%, much of which can be attributed to cultured salmon. During the same period, real value rose 261%, which is less than the increase in volume and indicates declining real export prices.

Figure 7-14 shows the value of eight product categories imported from 1984 to 1993. Product categories are frozen groundfish blocks, frozen groundfish and flatfish fillets, fresh groundfish and flatfish fillets, canned tuna, fresh lobster, frozen lobster, shrimp products, and scallops.

Derived Demand for U.S. Species

Foreign demand for U.S. fishery products generally benefits U.S. fishermen and processors. However, there can be unintended consequences from such trade when access to the resource is unlimited. One current example is the strong demand in Japan for roe of the sea urchin, which has traditionally been thought of as a "trash" species by U.S. harvesters. Sea urchin roe is now the second most valuable export from the Northeast Region and has increased in value 344% since 1991. Exporting processed sea urchin roe rather than live sea urchin benefits U.S. processors because the product has a higher value. Labor employed by U.S. processors benefit from jobs and income. Fishermen are also able to fish for sea urchins after their traditional fishing season ends, with very little conversion costs. Most sea urchins are harvested by divers in coastal Maine working from commercial fishing vessels between September and March. This period coincides with the end of lobster and gillnet fishing and provides alternative activities for vessels to engage in until the next fishing season.

Although these exports have undoubtedly benefited Northeast fishermen and processors, it is uncertain how long the resource can be extracted at the current rate. The sea urchin fisheries in California, Oregon, and British Columbia all displayed signs of overfishing after short periods of heavy exploitation (Creaser[7]). Between 1987 and 1993, landings in the Maine sea urchin fishery increased from 1.4 to 40.3 million pounds and from $0.26 million to roughly $26.1 million in value. Between 1992 and 1993, the number of licenses to harvest sea urchins by hand in Maine increased almost 80%, and the number of boat licenses more than doubled (Creaser[7]). Along with the possibility of resource depletion, there is a strong likelihood that the region's resource rents from sea urchins are being dissipated in excess labor and diving gear and in processing capacity. Although increased export of U.S. processed products is a desirable goal, it is unlikely that this rate of harvest is sustainable.

[7]Creaser, E. P. 1994. Sea urchin catch/effort data. Proposal submitted to Natl. Mar. Fish. Serv. by Maine Dep. Mar. Resour., Augusta.

The Recreational Harvesting Sector

Marine angling is one of the most popular outdoor recreational activities in America (USDI, 1991). In 1991, 9.5% of the population of the New England coastal states and 5.9% of the population of the Mid-Atlantic coastal states participated in marine recreational fishing within their own state (NMFS, 1991; Bureau of Census, 1992). These anglers create a demand for a wide variety of goods and support services. Businesses that supply these goods and services are collectively referred to as the marine recreational fishing industry. This industry employs thousands of Americans, and accounts for sizeable capital expenditures.

Summary Statistics

The total number of finfish caught in the Northeast Region by anglers has generally declined over the past 10 years (Figure 7-15). Following the peak annual catch of the decade in 1986 (203.8 million), successive declines occurred and reached a 10-year low in 1989 (89.2 million). Since then catches have climbed slightly to 101.6 million fish in 1993, a 12.4 million increase over 1989.

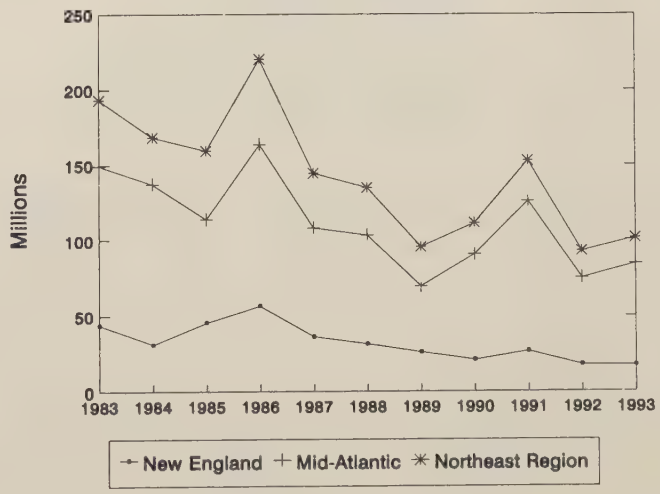


Figure 7-15
Estimated number of fish caught by recreational fishermen in the Northeast, by subregion.

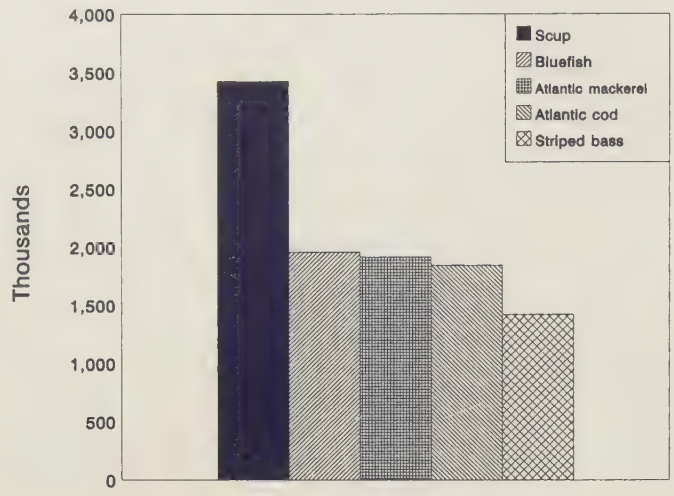


Figure 7-16
Top five species caught by recreational fishermen in New England in 1993.

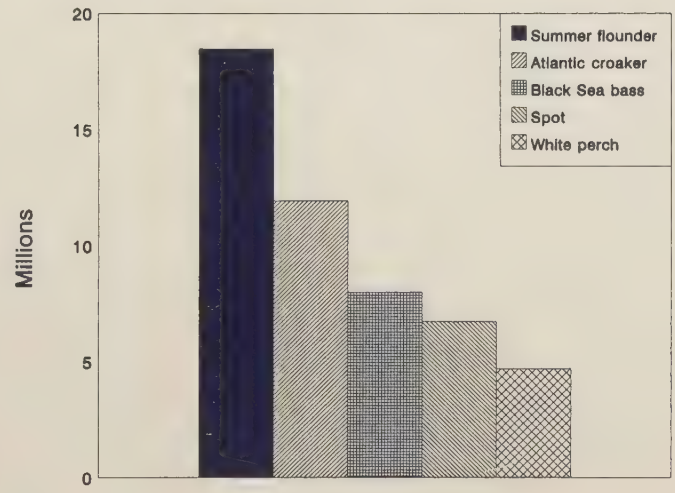


Figure 7-17
Top five species caught by recreational fishermen in the Mid-Atlantic in 1993.

Scup, bluefish, Atlantic mackerel, Atlantic cod, and striped bass were the most commonly caught species (in that order) in New England in 1993 (Fig. 7-16), comprising roughly 61% of the total catch in number. Summer flounder, Atlantic croaker, black sea bass, spot, and white perch were the most commonly caught species in the Mid-Atlantic in 1993 (Fig. 7-17), comprising roughly 59% of the total catch in number.

The annual number of fishing trips taken (effort) in New England and the Mid-Atlantic decreased roughly 4.5% during the past decade. In New England effort fell about 5%. An estimated 18.7 million fishing trips were taken in 1993, down from 32.4 million in 1983 (Fig. 7-18). Anglers in the Mid-Atlantic account for about twice as many trips as their counterparts in New England. This is partially attributed to the longer fishing season in the Mid-Atlantic.

Private or rental boats accounted for the highest percentage of the fishing effort over the last decade (Fig. 7-19 and 7-20); these types of fishing trips declined from 15.2 million in 1984 to 9.7 million in 1993. Private/rental boat anglers also accounted for the highest percentage of fishing effort within each subregion. However, in New England, shore anglers outnumbered private/rental boat anglers for the first time during 1991 and again in 1993. Overall, effort declined significantly in all modes, with the party/charter mode accounting for the largest relative decrease during the past 10 years (7.1%).

The number of residents of coastal states who participated in marine recreational fishing in their own state fell roughly 5% over the past 10 years. In 1993, about 2.6 million residents of coastal states in the Northeast Region participated in marine recreational fishing in their own state, a 1.7% increase from the ten-year low level of participation during 1992 (Fig. 7-21).

Federal and Northeast State Fishery Management

Upon implementation of the MFCMA, two councils were established to manage the commercial and recreational fisheries within the EEZ of the Northeast Region: the New England Fishery Management Council (NEFMC) and the Mid-Atlantic Fishery Management Council (MAFMC). Individual state governments have regulatory jurisdiction and authority in their terri-

torial seas (from their coastline to 3 miles offshore).

The Atlantic States Marine Fisheries Commission (ASMFC), formed in 1942, was the first interstate commission authorized by Congress to deal with marine fishery conservation (Royce, 1989). Since 1980, through a cooperative agreement with NMFS, the ASMFC has developed numerous interstate coastal fishery management plans. Several plans involve recreational fisheries. Historically, the responsibility for managing the Atlantic coastal fisheries rested primarily with individual state governments (Section 306, MFCMA). Thus, coastal states were not required to implement and enforce the measures of any ASMFC plans. Often, this multijurisdictional arrangement resulted in inconsistent management strategies for marine finfish that migrate across jurisdictional boundaries.

Given the importance of marine fisheries and the need for effective, mutual implementation of fisheries management programs among the states of the Atlantic coast, the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) was signed into law in December 1993. This landmark fisheries legislation directs the ASMFC to adopt fishery management plans for coastal fisheries and establishes an affirmative obligation on the part of states to implement the ASMFC's plans. While ACFCMA regulations shall be superseded by any conflicting Federal regulations in the EEZ (Section 804), the legislation promotes mutual state and Federal development of conservation programs. Most importantly, the legislation authorizes the Secretary of Commerce to declare a moratorium on any state that does not comply with the provisions of an ASMFC management plan (Section 806). States of the Atlantic coast must implement and enforce the measures of fifteen existing coastal fishery management plans developed by the ASMFC or be subject to a moratorium on all fishing for the species in question within the offending state until they come into compliance. In New England, five of the ASMFC fishery management plans involve recreational fisheries: summer flounder, winter flounder, herring, bluefish, and striped bass (managed by the ASMFC under the Atlantic Striped Bass Conservation Act (ASBCA). Furthermore, the Mid-Atlantic states will be required to come into compliance with an additional six ASMFC fishery management plans that involve recreational fisheries (red drum, spotted seatrout, weakfish, spot,

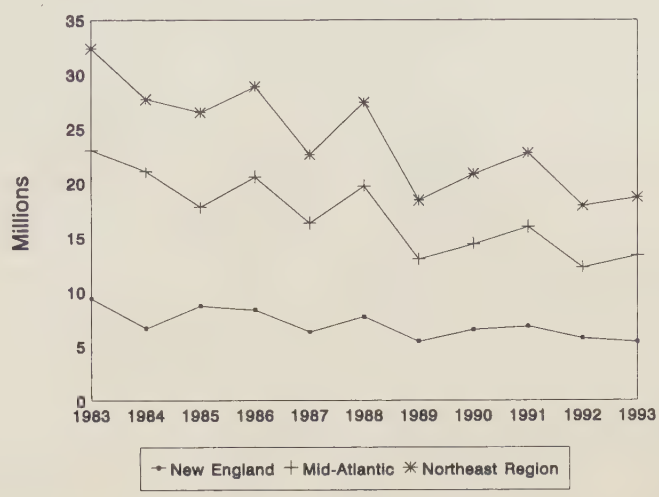


Figure 7-18
Estimated number of Northeast recreational fishing trips, by subregion.

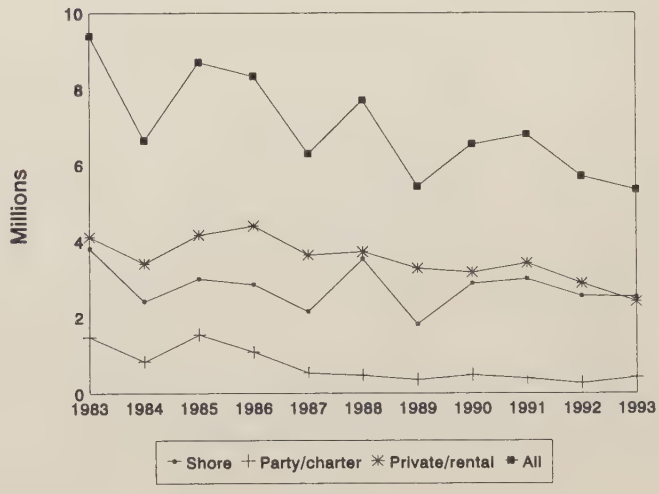


Figure 7-19
Estimated number of recreational fishing trips in New England, by mode.

croaker, and Spanish mackerel).

Currently, nine Federal FMP's that affect recreational fisheries in the Northeast Region's EEZ are in place: Atlantic billfishes; Atlantic bluefish; Atlantic coast red drum; Atlantic mackerel, squid, and butterfish; Atlantic salmon; summer flounder; swordfish; sharks; and Atlantic tunas. These FMPs establish various recreational management measures including: possession limits, size limits, quotas, seasonal and area closures and, in the case of Atlantic salmon and striped bass, a complete moratorium in the EEZ (recreational and commercial). For some mixed recreational-commercial fisheries, such as bluefish and tunas, the total allowable catch has been explicitly allocated between recreational and commercial user groups. To reserve the Atlantic billfish resource for its traditional use, the fishery has been declared unconditionally for recreational use only (FMP for Atlantic billfishes).

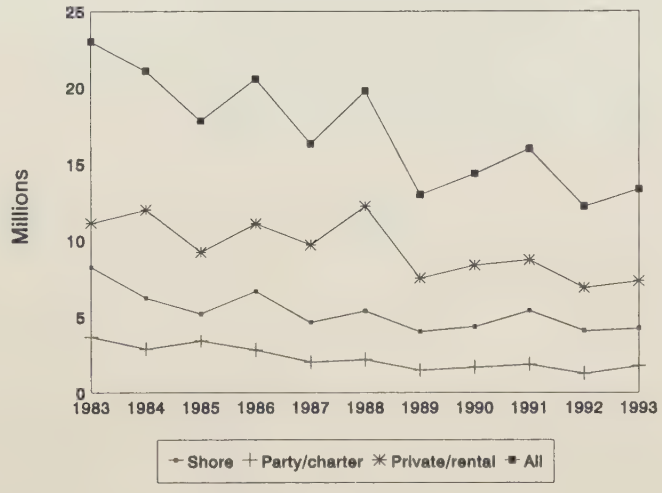


Figure 7-20
Estimated number of recreational fishing trips in the Mid-Atlantic, by mode.

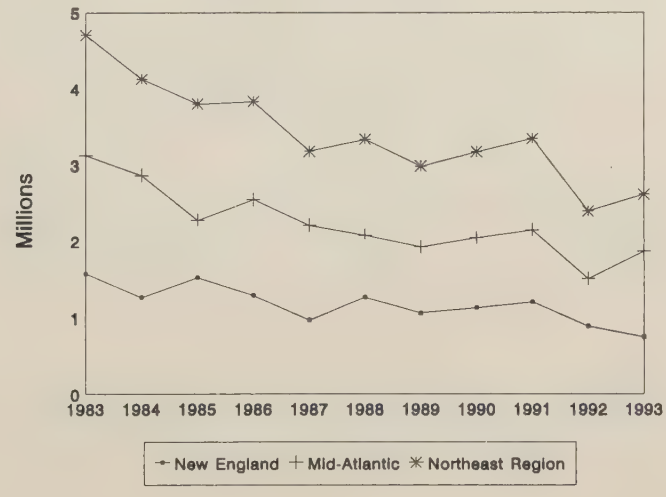


Figure 7-21
Number of in-state recreational fishing participants in the Northeast, by subregion.

Management by Allocation

In the Northeast, the competition between commercial and recreational fishermen for limited stocks of fish has intensified as a direct result of increased demand for seafood, a general decline in the quality of the marine environment, and technological advances in harvesting gear. Consequently, the need for management of mixed recreational-commercial fisheries has grown.

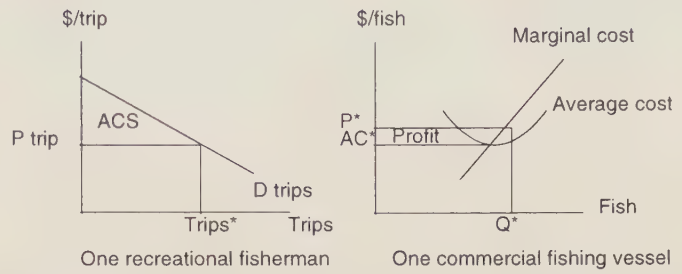
In overexploited fisheries, resource managers have been compelled to allocate fish stocks through various management measures amongst commercial and recreational fisheries in an attempt to reduce harvesting levels over time. Given the financial stakes in having access to a fish stock, allocation of many shared species has become a highly controversial and increasingly adversarial process.

Economics in Northeast Allocation Decisions

While descriptive economics data have certainly been included in all FMP's in the Northeast Region, fishery managers have made only modest attempts to use these data to allocate fish resources. Instead, all of the FMP's either explicitly or implicitly recognize the "traditional use" of the resource and typically allocate based on historical catch shares. Often purely financial information, such as expenditures and revenues, are inappropriately used to give ex post justification to the proposed allocations. For example, one of the objectives of the bluefish FMP is to "Provide the highest availability of bluefish to U.S. fishermen while maintaining, within limits, traditional uses of bluefish—defined as the commercial fishery not exceeding 20% of the total catch" (Section 4.3 Fishery Management Plan for

the bluefish fishery).

Clearly, the prescribed allocation between commercial and recreational fishermen is based on historical catch shares alone; the allocation scheme was not driven by economic objectives. Because angler consumer surplus or producer surplus were not estimated, the relatively low level of employment and income attributable to bluefishing activity in the commercial sector relative to the recreational sector was inappropriately used to rationalize the currently maintained 80/20 allocation. Using these measures of economic impact to rationalize allocation decisions, or as a means of making resource allocation decisions, ignores the fact that society is better off when commercial fishermen minimize fishing costs. The ability to project financial effects is important to manufacturers and local and state governments to find out how fishery regulations might affect their share of markets and revenues, including taxes (Edwards, 1990); but this information does not provide a reliable measure of value for making or evaluating alternative resource allocation decisions[8].



The net economic benefit from the recreational fishery is the willingness-to-pay over and above the cost of a trip, or the angler consumer surplus (ACS). The net economic benefit from the commercial fishery is the profit, or rent, generated. Allocation based on maximizing total net economic benefit provides the greatest economic benefit to the nation.

Economic Data

Although it is clear that a gain in economic efficiency implies a gain of net national benefits, to date economic efficiency has not played an important role in resource allocation decisionmaking in the Northeast Region. Often, analyses are constrained by a lack of appropriate economic data. This is due in part to serious limitations in current guidance and standards on acceptable economic methodologies in the MFCMA that impede the development of consistent economic evaluation approaches.

Currently, two public sector surveys collect information on marine recreational fishing in the Northeast Region: 1) the Marine Recreational Fishery Statistics Survey (MRFSS), and 2) the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (NSFHW). The information obtained from these surveys allows resource managers to track trends in catch rates, participation, and expenditures on marine recreational fishing but does not provide the necessary data for economic value assessments. Thus, fishery managers have been forced to rely upon fairly specialized private sector data collection and analysis developed under disparate viewpoints and guidelines to address allocation decisions in an efficiency framework. For example, in the Billfish FMP, the regional councils approved a prohibition on commercial sale of billfish by concluding that recreational uses of billfish had greater economic value than commercial uses. The allocation decision was approved despite the fact that no estimates of ex-vessel or retail demand were available for the commercial sector, and the recreational values were derived from only one study of billfish limited to a small portion of the Atlantic Region[9]. While the Councils sought to maximize economic efficiency, the unconditional recreational allocation was difficult to substantiate due to data limitations.

Recently NMFS has expanded efforts to collect marine recreational economic data needed to make rational allocation decisions in the Northeast. A comprehensive economic survey of recreational anglers in the region was designed to help fill the economic data and research gap in our knowledge of marine recreational fishing. The research is motivated by the idea that the economic value of marine recreational fishing will be an essential component in future fishery management issues and a foundation with which future recreational policies can be evaluated is critical.

Objectives of the economic survey were to: 1) collect demographic and economic data on marine recreational fishing participants, and 2) to estimate statistical models of the demand for marine recreational fishing for eight important re-

[8]For more information on the methodology used to describe the links among industries (in terms of employment, expenditures and revenues), consult Edwards (1990); see Storey and Allen (1993) for applied use of economic impact analysis.

[9]New Jersey. See Atlantic Billfishes FMP, Appendix 1.

creational species that are either currently managed or are expected to be managed in the near future. The information will be used to answer questions about the economic value of or costs of two common forms of regulations imposed on anglers: 1) restrictions on participation in or access to fishing, and 2) methods that change anglers' catch (e.g., creel limits, catch and release, minimum size).

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Northeast Spotlight Article

The Surf Clam ITQ Management: An Evaluation[1]

The U.S. surf clam offshore fishery, primarily off the Mid-Atlantic region, was the first fishery managed with a limited entry and individual transferable quota (ITQ) system under the Magnuson Fishery Conservation and Management Act (MFCMA). A vessel limited entry system was implemented for the period 1977-1990 and an individual transferable quota system from 1990 to date.

In 1977, the surf clam offshore fishery was brought under Federal management because of over-exploitation and natural disaster. The surf clam biomass had declined to a historic low after a period of high exploitation in the early 1970's, yet new capital and vessels continued to enter the fishery. This over-exploitation was aggravated by an anoxic habitat condition off the New Jersey coast in 1976 which destroyed an estimated 25% of the New Jersey offshore surf-clam fishery and ruined almost 70% of the entire fishery by the fall of that year.

The 1977 Federal surf clam management system established a limited entry program consisting of a vessel moratorium, an annual fishery catch quota, limitations on vessel fishing hours, catch logbooks, and vessel permits. Other measures such as minimum clam size were added in later years. Under the vessel moratorium, only vessels that directed their fishing on surf clams between November 1976 and November 1977 were allowed to fish for surf clams, with provisions to qualify surf clam vessels that were already under construction. The fishery quota was established and set with a range of 1.8-2.9 million bushels for the Mid-Atlantic area and 0.025-0.1 million bushels for the New England area. Allowable fishing time was specified to maximize fishing seasons. However, the allowable fishing time was steadily shortened thereafter due to continuous increases in the fishing power.

When first instituted in 1977, the vessel moratorium program under the limited entry system was authorized only for 1 year with the intent that the program would be replaced with an alternative one such as a stock certificate program. However, the moratorium program was continued until 1990 while an alternative program was under development. During that time, the allowable fishing time was reduced substantially to a historic low: a surf clam vessel was only permitted to fish 6 hours every other week by 1990. This resulted in low capacity utilization of fishing vessels and economic inefficiency of fishing firms. Under the moratorium, the administration of the fishing time on the basis of individual vessels was also an administrative burden for the Federal government. Consequently, the Federal government, the Mid-Atlantic

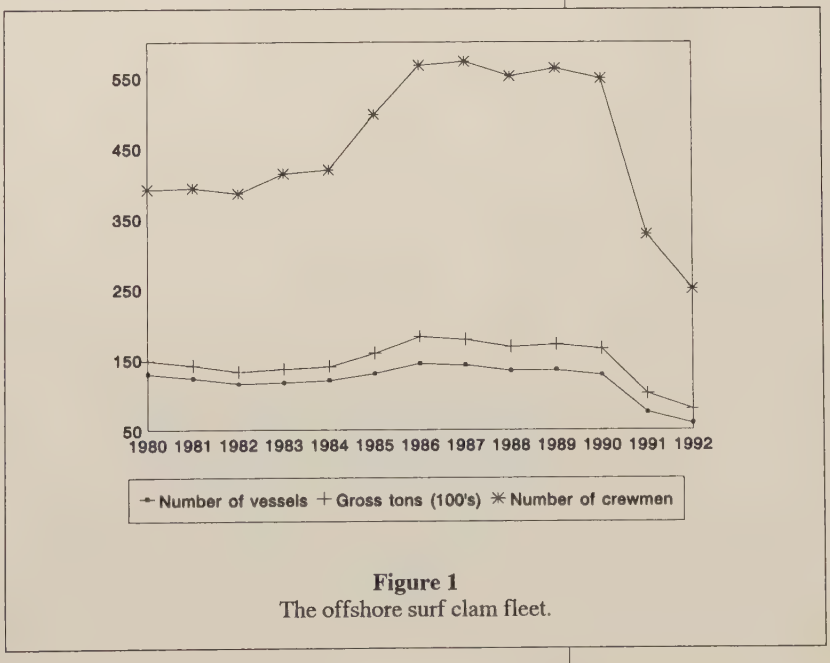


Figure 1
The offshore surf clam fleet.

[1]This is an excerpt from an NMFS unpublished manuscript entitled "The performance of U.S. Atlantic surf clam and ocean quahog fisheries under limited entry and individual transferable quota systems" by Stanley D. Wang and Vuong H. Tang, NMFS Northeast Regional Office, Gloucester, Mass., Jan. 1994.

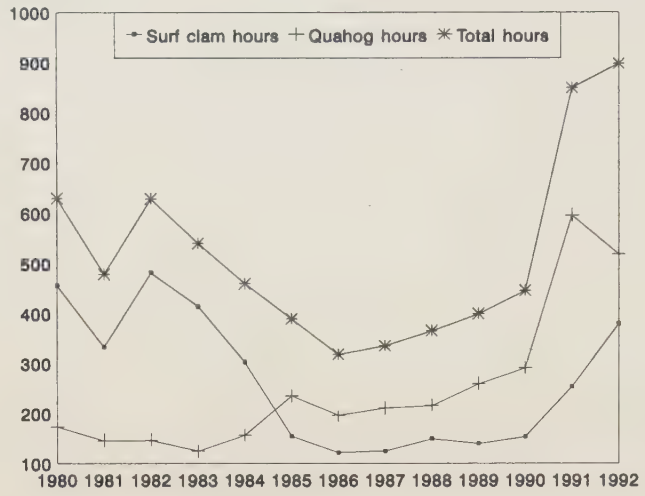


Figure 2
Fishing hours per offshore surf clam vessel.

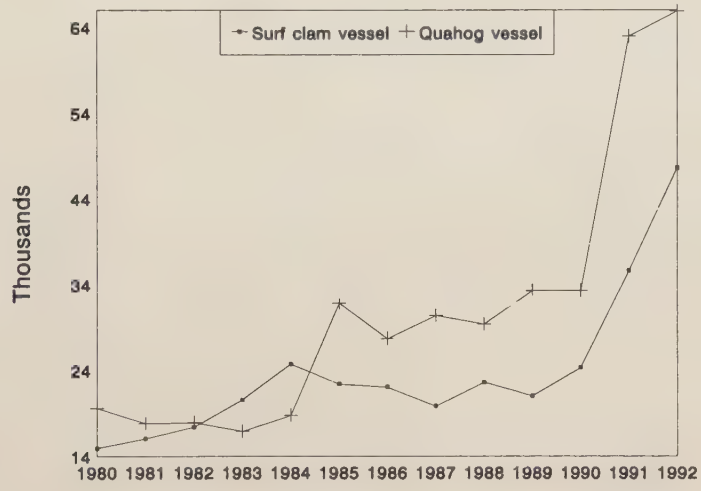


Figure 3
Landings per offshore surf clam vessel.

Fishery Management Council, and the surf clam fishing industry were not satisfied with the vessel moratorium program. Finally, the vessel moratorium program and the entire limited entry system were replaced with an individual transferable quota (ITQ) system in October 1990.

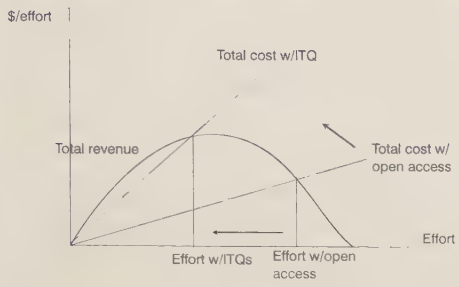
Initial ITQ shares of the fishery quota were issued to vessel owners based on a formula of historical catches (80%) and vessel size (20%). The ITQ shares can be traded or leased to any person or entity without preconditions of vessel ownership or limits on the amount of ITQ shares owned by an entity. Vessel operators may fish any time with ITQ certificates. In addition, former effort control measures as well as minimum clam size regulations have been eliminated.

Substantial capital savings have accrued to the surf clam offshore fishery under the ITQ system. The surf clam offshore fleet shrank from 128 to 59 vessels (Figure 1) within 2 years of the implementation of the ITQ system in 1990. This represents a 54% reduction in fleet and a historical low since 1980. Total gross tonnage of the surf clam fleet shrank by 52%. A comparison between the 1986 peak level of capitalization under the limited entry system and the 1992 level under the ITQ system reveals that the capital savings under the ITQ system amounted to 85 vessels, totaling 9,950 gross tons, and about 320 crew members. This means that more capital and labor became available for employment in the other industries to benefit the U.S. economy. Of course, some economic and social dislocation has occurred in the process.

The ITQ system allowed for the consolidation of crew and retirement of vessels and resulted in a substantial increase in the capacity utilization of fishing vessels remaining in the fleet. For example, the surf clam fishing hours per vessel increased by one and a half times, from 154 hours in 1990 under the limited entry system to 380 hours in 1992 under the ITQ system (Figure 2).

The ITQ system also improved vessel productivity to record levels. The 1992 surf clam catch per vessel under the ITQ system was 47,656 bushels, an increase of almost 100% from the 1990 catch level under the limited entry system (Figure 3). Average catch per gross ton under the ITQ system exhibited an increase as well. As a result, the ITQ system should lower fishing costs and improve earnings of the remaining surf clam fleet.

The ex-vessel price of surf clams declined as the landings of surf clams increased during the period from 1980 to 1992 (Figure 4). The 1992 ex-vessel price under the ITQ system was the lowest for the period. The surf clam price continued to decline from 1987 to 1992 even with the drastic decline in the landings in 1987. This continual price decline is partially attributable to increasing substitution by consumers of ocean quahogs for surf clams. The price decline may also be associated with high buyer concentration in the ex-vessel market.



Implementation of an ITQ program results in increasing costs due to the private costs of acquiring (or not selling) the quota. Effort is decreased to levels closer to maximum economic yield.

A small number of buyers has dominated the surf clam market. The market shares of large surf clam buyers declined steadily during the late period (1985-90) under the limited entry system, but increased again under the ITQ system (Figure 5). The 1992 combined market share of the three largest buyers was approximately 75%, a historic high since 1986, indicating the surf clam ex-vessel market became more concentrated under the ITQ system.

Under the ITQ system, ownership of ITQ shares by processors has replaced the ownership of vessels as a way to secure the supply of surf clams as raw materials. Prior to the ITQ system, only surf clam vessels under the limited entry program were allowed to fish in the Mid-Atlantic area, the predominant fishing ground. To secure the supply of surf clams, vertically-integrated processors owned and operated surf clam vessels. Currently, however, any U.S. registered vessel is allowed to fish surf clams under the ITQ system as long as ITQ certificates are owned. As a result, some of the processors have abandoned their vessel operations and focused on securing the ownership of the ITQ shares.

Not surprisingly, the number of unique ITQ owners has declined since the implementation of the ITQ system. The initial surf clam ITQ shares were allocated among 67 vessel owners[2]. By March 1992, the number of the ITQ owners had declined to 50 unique owners. Between October 1990 and March 1992, there was a slight increase in the concentration of ITQ ownership. During this period, the three largest owners' ITQ shares rose from 51.3% to 58.1%.

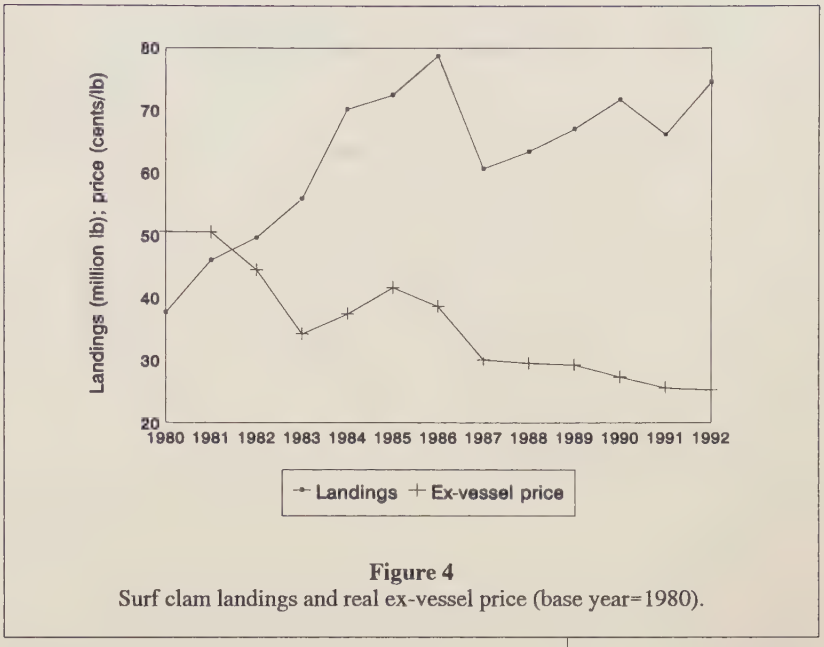


Figure 4
Surf clam landings and real ex-vessel price (base year=1980).

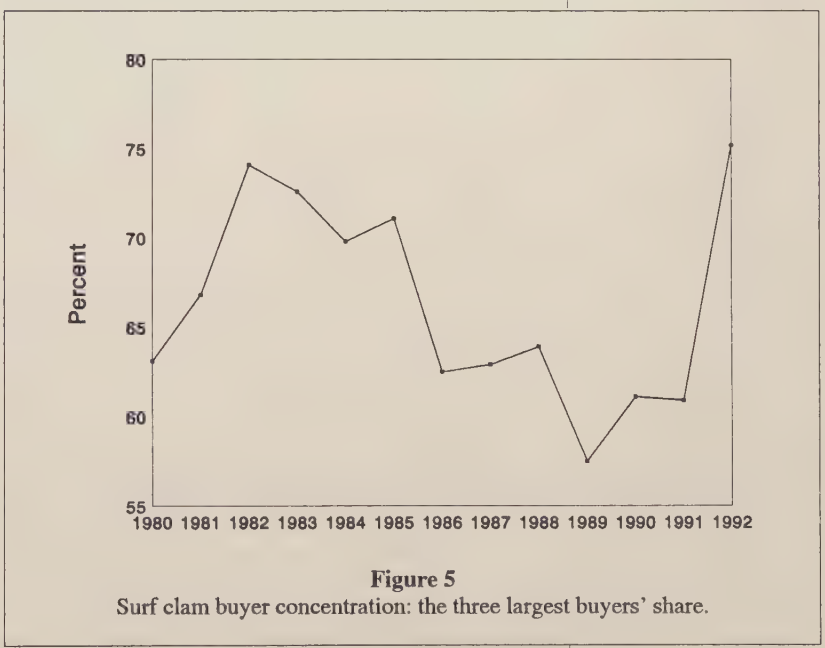


Figure 5
Surf clam buyer concentration: the three largest buyers' share.

Based on an NMFS interview with some industry members in February 1992, the surf clam ITQ's were traded for about $20.00 a bushel and leased for about $4.00 per bushel annually. Accordingly, the offshore surf clam resource with a quota of 2.85 million bushels was evaluated at about $57 million in 1992. The 1992 rental value of the surf clam ITQ shares was estimated to about $11.4 million, resource rent captured en-

[2]In October 1990, 161 vessels received the original ITQ shares. Of these, 154 vessels had surf clam ITQ's and 117 owned ocean quahog ITQ's. However, the number of unique owners is smaller than the number of eligible vessels due to multi-vessel ownership.

tirely by the industry rather than being dissipated due to lack of property rights.

In summary, the 1977 limited entry system consisting of a vessel permit moratorium and a fishery quota was not sufficient to deal with the issues of overcapitalization and its associated inefficiency in the offshore surf clam fisheries. Under the limited entry program, even though the fishery quota was relative stable, fishing capacity increased continually because vessel sizes were increased, newer and more efficient fishing gears were adopted, and fishing labor was more intensively employed. The ITQ management system, implemented in 1990, made it possible for fishing firms to use and respond to market mechanisms and forces in their business operation. The result is that the fishing industry has reduced its overcapitalization and achieved greater economic efficiency. Within 2 years of the implementation of the ITQ system, the fishing fleet reduced its size by 54% and vessel capacity utilization and productivity rose to a record level. Further, the surf clam resource rent created under the ITQ system amounted to $11.4 million for the original vessel owners in 1992.

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Appendix 2

Acronyms and Abbreviations

ACS	Angler consumer surplus
BRD	Bycatch reduction device
CAC	Command-and-control
CBA	Cost-benefit analysis
CDQ	Community Development Quota
CPUE	Catch per unit effort
CS	Consumer surplus
CV	Contingent valuation
EEZ	Exclusive Economic Zone
EIA	Economic impact analysis
ESA	Endangered Species Act
ETP	Eastern Tropical Pacific Ocean
FC	Fixed costs
FMC	Fishery management council
FMP	Fishery management plan
GMFMC	Gulf of Mexico Fishery Management Council
ITQ	Individual Transferable Quota
JV	Joint venture
LMR	Living marine resource
MAFMC	Mid-Atlantic Fishery Management Council
MC	Marginal cost
MEY	Maximum economic yield
MFCMA	Magnuson Fisheries Conservation and Management Act
MMPA	Marine Mammal Protection Act
MPC	Marginal private cost
MRFSS	Marine Recreational Fisheries Statistics Survey
MSB	Marginal social benefits
MSC	Marginal social cost
MSY	Maximum sustainable yield
NEB	Net economic benefits
NEFMC	Northeast Fishery Management Council
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPFMC	North Pacific Fishery Management Council
NPV	Net present value
PFMC	Pacific Fishery Management Council
PS	Producer surplus
SAFMC	South Atlantic Fishery Management Council
TAC	Total allowable catch
TC	Total cost
TED	Turtle excluder device
TSR	Total sustainable revenue
WPFMC	Western Pacific Fishery Management Council
WTP	Willingness to pay

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